N64-23519
Code 1
NASA CR 56561

NSP-64-24 ● APRIL 1964

NSP-64-24

Cat. 27

RIFT NRDS OPERATIONS PLAN

Report 504, Contracts NAS 8-5600 and NAS 8-9500

OTS PRICE

XEROX $ 11.00 ph

MICROFILM $ ________

NSP-64-24 • APRIL 1964

NSP-64-24

RIFT NRDS OPERATIONS PLAN

Report 504, Contracts NAS 8-5600 and NAS 8-9500

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FOREWORD

This document describes LMSC plans for carrying out the RIFT Stage Captive Test Program at the Nuclear Rocket Development Station in Nevada. It was prepared as an initial submittal of Report 504 to meet requirements of the Contract NAS 8-5600 Data Submittal Document. It is now submitted in partial fulfillment of the RIFT documentation task of Contract NAS 8-9500.

At the time of preparation, the document was intended to serve as a basis for long-range requirements forecasting and, secondarily, as a utilization study covering a concept of NRDS facilities and ground support equipment then in a conceptual design stage of materialization. As drafted, the document had a preliminary and tentative character. In consequence of the cancellation of the RIFT Program, the document is now submitted as a final record of the operational concepts for captive testing RIFT stages that were under consideration at the time of the cancellation. The finality of its submittal should not mask the tentativeness of its assumptions.

Because of the emphasis given to planning in the RIFT Program, the document should prove useful as a starting point for planning future complex test operations at remote sites.

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Section 1
OBJECTIVES, GOVERNING POLICIES, DIRECTIVES, AND ASSUMPTIONS

1.1 MISSION OF RIFT NRDS OPERATIONS

It is the mission of RIFT NRDS Operations to ready test articles and equipment for test, to conduct nuclear-powered captive test runs on RIFT stages, and to report test experience and test data derived from them, as prescribed and regulated by applicable plans, policies, and directives. This is done to accomplish the following:

- Further the development of RIFT stages
- Establish the reliability of RIFT stages and stage systems
- Qualify RIFT stage design for flight test
- Qualify RIFT GSE for use in launch operations
- Evaluate stage performance
- Prove operational procedures
- Provide experimental support to the RIFT Flight Safety Program
- Furnish environment for side experiments
- Furnish support for MSFC tests of the RIFT IU.

The mission consists of a statement of the task of RIFT NRDS Operations, a reference to governing authority of higher and associated organizations, and a statement of the purpose of the operations. The purpose is introduced in the next paragraph and the detailed development of the plan follows.

1.2 PURPOSE OF RIFT NRDS OPERATIONS

Operations must be conducted so that test results from them are meaningful. To do this, the configuration of test articles must be carefully controlled and completely documented; test conditions that are imposed and those encountered must be consistent with test specifications and must be unambiguously reported; test data supplied to analysis organizations must be identifiable as to source, method of acquisition, time, and accuracy; and post-test actions must be paced and controlled so that post-test inspections and measurements are not precluded or invalidated.

The nine purposes itemized in Section 1.1 are to be served by RIFT NRDS operations. In most respects, fulfilling any one of the purposes will automatically contribute to the fulfillment of the rest as well. Yet each will influence, somewhat differently, the way the operations are to be conducted. The consequences of fulfilling each particular purpose are discussed separately in following individual sections.

1.2.1 Furtherance of Development

Merely conducting a successful run or a successful function generally contributes little to further development, and may even retard development by removing any apparent need for it. To further development, a primary objective will be to acquire maximum data that are directly comparable with those that were assumed or calculated in design studies. Normally, data will be desired for as wide a range of test conditions from some design point as is allowable. Frequently, the information most needed by the designer will be of a dynamic and synergistic character, since information of a static or specific environment character will usually be more readily obtainable from simpler tests.

In some cases, it may be true that completely satisfactory development test data can be obtained from a test run that is only partially successful from the overall point of view. Nevertheless, the expense of a captive test run, and the likelihood of unpredicted interactions affecting test results in the event that all systems do not perform correctly, makes it necessary that test preparations be thorough and complete and that procedures be subject to strict control for development testing as well as for other testing. In development testing, the unforeseen is to be expected; otherwise the testing would not be justified for development purposes. This being so, complete reliance cannot be placed on preprogrammed automatic test control equipment for development testing. Rather, equipment used for such testing must be designed and configured to afford human operators the greatest possible facility for using intelligent judgment to influence the course of the tests and to diagnose behavior. Test procedures should include actions that the operator may elect to take in event of unforeseen test article behavior.

1.2.2 Establishment of Reliability

Assessment of reliability usually involves either testing many identical items under identical conditions for successful behavior or testing a smaller number to failure through a series of increasingly severe overtests. Because only a few captive test articles are to be provided, and because testing to failure can involve difficult post-test problems, reliability test results derivable from the RIFT NRDS test operations will be limited. Thus it is all the more important that such reliability data as are derivable be based on unambiguous test results. This means that extensive effort will be required to keep the configuration of all captive test stages updated and as identical to one another as possible. It also means that uniform procedures must be strictly followed, both in stage preparation and in conducting tests where assessment of reliability is a primary objective. It is especially important to establish formal procedures and control operational activity so that extraneous influences and inadvertences do not prevent a test run from being an unqualified success, when under proper conditions it would have been. Detailed documentation of all systems and actions at the time of testing will be very important.

1.2.3 Stage Qualification Testing

Rigorously, a test to qualify the RIFT stage design for flight must be run on a stage that is configured, manufactured, and prepared for test exactly as flight stages are. Further, the test must impose initial conditions and ambient environment that are the same as those to be experienced by the stage in the course of launch and flight. Neither of these requirements will be fully met in captive testing. Captive test article design will be different in certain particulars, to make the stage compatible with the captive test stands or to carry out certain operations after the stage become radioactive. Radiation scattering by ambient air and stand materials will subject the captive test stages to a radiation environment different from that experienced by flight stages. Atmospheric pressure into which the engine and other vents and nozzles exhaust may be reduced in captive tests, but altitude simulation will not be complete. The partial vacuum applied to the tank bottom and lower skirt resulting from altitude simulation, opposed by full atmospheric pressure acting on the sides and top of the stage will cause stage loading to be different in ground and flight tests.

Fixing the lower skirt ring to the test stand will also cause a nonflight-like perturbation to the structural loading during captive tests. Nevertheless, stage captive tests will come much closer to being combined environment tests of the integrated RIFT stage than will any other type of testing, short of the flight tests themselves. For this reason, a majority of the captive tests will have stage qualification as a primary objective; such tests will be planned and executed so that the results derived from them can be the basis of stage qualification, subject to a minimum number of reservations. In runs designated as stage qualification tests, emphasis will be on achieving maximum possible simulation of launch operations and flight sequence.

The configuration of test stages will be held as close to as-manufactured S-N-x (i. e., flight stage) configuration as possible. In stage checkout, maximum practical use will be made of preprogrammed automatic equipment with both hardware and software closely approximating that used in launch operation stage checkout. The countdown for captive test and the test sequence after simulated launch in stage qualification tests will follow stipulated launch and flight sequences to the maximum extent feasible. Sequencing will be automatic where advantageous. The data of most importance in qualification testing will be those measuring performance parameters stipulated in stage specifications. Data derived from radio frequency telemetry links will be especially important, because the whole success of a flight test depends upon acquiring meaningful data from this source.

1.2.4 Qualification of GSE for Launch Operations

The main requirement here is that the configuration and use of the portion of the RIFT NRDS GSE that is duplicated at the launch area be the same as that applying to launch area GSE. Ideally, the launch area GSE installed in the NAB should be duplicated by

GSE installed in the RIFT NRDS stage preparation facility; similarly, launch area GSE installed for use in launch operations should be duplicated by GSE installed in the NRDS captive test control center for use during countdown preceding simulated lift off.

Differing organizational responsibilities for providing GSE for captive test and launch operations, however, together with the inherently different functional requirements for GSE for the two purposes, preclude achieving the ideal similitude. Rather, the aim will be restricted to qualifying in NRDS only the GSE used in stage preparation checkout and perhaps particular elements of other GSE, such as flight umbilicals and various handling equipments.

1.2.5 Evaluation of Stage Performance

For this purpose, a redundant set of measurements must be made to evaluate the performance of the flight stage measurement systems as well as other systems in the stage. Moreover, to diagnose the exact sequence and character of any failure that might develop during a test run, certain data should be recorded in the form of direct analog records without time sharing or other limitation of transient response.

To diagnose any puzzling aspect of stage behavior that may be revealed during flight tests, captive test runs may be necessary, with postulated abnormalities intentionally imposed so that performance can be examined in detail and stage data system transmissions can be compared with those received during the flight test in question.

1.2.6 Proof of Operation Procedures

Fulfilling this purpose correctly implies that experimentation with procedures, including both automatically and manually executed test programs, will be consummated prior to captive test runs. Test runs will be of the nature of proof of developed and tested procedures. Experimentation with and testing of procedures, therefore, will be conducted on stage simulators and dummy stages. It will be necessary that the simulators used be kept updated to the current or planned configuration of the item being simulated. Tight control of procedures during the development, as well as the employment of them, is mandatory.

1.2.7 Experimental Support to the RIFT Flight Safety Program

(To be described in a later revision of the Operations Plan.)

1.2.8 Side Experiments

By their very nature, side experiments play a secondary role in the RIFT NRDS operations and will be included in test plans generally on a not-to-interfere basis. Once side experiments are accepted, however, test plans and procedures will have to be coordinated with the sponsoring organizations of the side experiments, so that sought for results will not be vitiated by actions taken in the interests of the primary effort. Because of this, side experiments should be allowed only in cases where the need is clearly great and urgent.

1.2.9 RIFT Instrument Unit (IU) Tests

A portion of the stage captive test runs will have as one of their purposes, qualification of the integrated stage-instrument unit design for the RIFT flight environment. Inasmuch as all captive test stages that do not have an IU will have an IU simulator, test control and monitoring with and without the instrument unit should be substantially the same. However, to acquire data from and to checkout, the IU MSFC will require additional space and equipment, and RIFT NRDS Operations will be required to support the MSFC force that has responsibility for checkout and data acquisition for the IU.

1.3 GOVERNING PLANS, POLICIES, AND DIRECTIVES

1.3.1 RIFT Stage Overall Program Plan (NSP-62-51)

The RIFT Stage Overall Program Plan sets forth program planning information with which this plan must be consistent. The salient provisions of the Program Plan directly affecting RIFT NRDS Operations follow:

a. Four stages will be provided for captive tests; they are designated
   - S-N-TA-2 consisting of a heavy gage propellant tank with flight type internal insulation
   - S-N-T-1, 2, 3, flight type ground test stages

b. Nine NERVA engines (GVX Block) will be provided for captive tests

c. The RIFT Program Master Schedule establishes basic time relationships (Fig. 5-1)

d. Responsibilities for RIFT NRDS facilities, tooling, and GSE are established in the matrix shown in Table 3-1.

e. The test program will be conducted in accordance with the requirements established in the Integrated Test Plan and detailed system test documentation.

f. Insofar as possible, all equipment necessary for the first hot firing of S-N-TA-2, as well as piggyback experiments, will be installed and checked out in the PTF.

g. S-N-TA-2 will be used for operational readiness demonstration (ORD) tests, and then for captive testing, to evaluate the propulsion system.

h. The primary facilities for RIFT captive testing will include these:
   - Stage Assembly and Maintenance Building (SAM)
   - Demating Facility
   - Stage Test Stand (STS)
   - Test Control Center (STCC)
   - Cooldown Area

1.3.2 RIFT Integrated Test Plan (NSP-62-05)

The RIFT Integrated Test Plan sets forth the test objectives that must be achieved in the various RIFT test programs to carry out the RIFT Program. It defines the individual tests for each test program and describes the results to be obtained from each test. It also prescribes the time relationship that must exist between the completion of various tests and other events in the program so that results from a given test may influence requirements and specifications for subsequent tests and may serve their purpose in allowing other aspects of the program to progress. The salient provisions of the Integrated Test Plan that influence RIFT NRDS operational planning are cited in Sections 1.3.2.1 and 1.3.2.2.

1.3.2.1 Definition of Captive Firing Series*

The seven initial test series and the choice of firing times, as presented in Table 1-1, are summarized below. Paragraph headings correlate with Table 1-1 column titles.

CT-1

A series of four CT-1 test firings is planned to allow a conservative buildup of engine firing-cycle durations. The first test firing will provide for a nominally zero engine-operating time at full power to determine the controllability of all onboard stage systems and to evaluate the adequacy of the test instrumentation to perform as required. After this initial confidence run, a second short-duration engine run at full power is planned to provide for an extensive shakedown. After enough time to analyze the accumulated data, the third engine run of longer duration is planned to allow for evaluation of heating and radiation effects. After the third test firing, it is presently planned to provide enough radiation cooldown time to permit personnel to make checks to determine the condition of the engine and stage. The final (fourth) firing of the test series will be of medium duration at full power to accumulate additional basic data regarding the system.

*Reproduced from "RIFT Integrated Test Plan," NSP-62-05.

CT-2

The second series of tests is planned for a slow buildup of stage firing duration for the same reasons previously outlined under CT-1, since this will be the first exposure of an S-N-T flight-weight stage with associated systems and the PFRT engine to the power-on environment.

CT-3 Through CT-5

CT-3 through -5 are planned to achieve the detailed objectives and to verify the system reliability.

CT-6 and CT-7

CT-6 and -7 are programmed for variations of the propulsion system operating cycle. This is planned as a tertiary objective following the successful completion of the previous primary and secondary objectives. These tests will provide basic information regarding application of S-N stage hardware in an operational mode requiring stage programming as typified in these tests. The variation of engine performance level will provide additional system reliability data by subjecting the total system to operating conditions which are more stringent than required.

CT-8 and Subsequent

Additional tests will be scheduled as backup to the first flight stage in the event that data from flight tests indicate a need for further development or verification of flight-test results.

The total firing times for each captive-test stage has been left short of design maximums so that additional firings may be accomplished if the evaluation of test data dictates a need for special test cycles. Also, this provision for additional time on each engine permits backup tests to be performed with a minimum of delay and with a minimum of effect on manufacturing efforts.

Engine Firing Cycle Definitions. Engine firing cycles presented in Table 1-1 are defined as follows:

- Engine Start: The time at which the main propellant valve (TSOV) opens and thrust buildup commences. This occurs after the initial engine subpower reactor startup phase.
- Engine Runup Cycle: The time required for the engine to reach 100-percent power following opening of the tank shutoff valve (TSOV).
- Operating Cycle: The time that the engine is operating at 100 percent of design power.
- Engine Shutdown Cycle: The elapsed time between the receipt of a shutdown signal, the closing of the TSOV, and the actuation of the cooldown interlocks. This time will vary as a function of the time at full-power operation.
- Second and Third Engine Runup Cycles: This represents an inflight engine restart after the initial start and cooldown process. The exact cycle time will depend upon reactor temperature and neutron density.
- Final Engine Cooldown Cycle: This phase will require additional coolant to be supplied from external sources for the NRDS tests. For planning purposes, the cycle will commence at the closing of the TSOV and be terminated after the time indicated in Table 1-1. This marks a change from the previous ITP definition of the cooldown phase which terminated when the coolant was switched to the external supply.
- Engine-Operating Time – Total: The total engine-operating time will be considered to extend from the TSOV opening to the TSOV closing.
- Total Test Duration: This includes the final cooldown period, the total engine-operating time, and the coast period between restarts.
- Engine Coast (First or Second): A period when no thrust except that provided by the coolant flow is delivered by the engine.

1.3.2.2 Captive Test Program Objectives*

The Captive Test Program will evaluate the safety, reliability, compatibility, and structural integrity of the nuclear stage, stage instrumentation unit, and stage/engine interfaces under simulated flight conditions.

Primary

(1) Demonstrate the captive-test operational safety, functional compatibility, and structural integrity of the nuclear stage under 0 to 100-percent engine-thrust conditions, for both normal- and emergency-shutdown cycles

(2) Demonstrate the capability of the GSE to perform handling, checkout, and hot-engine operational functions

(3) Demonstrate the capability of the stage to fulfill minimum flight-profile requirements (Overall Performance – Engine With Stage)

(4) Determine the reliability of all stage/engine systems to establish flight-test confidence factors

Secondary

(1) Demonstrate stage internal systems operability

(2) Demonstrate propulsion system operability and controllability

(3) Confirm thermodynamic and radiation design criteria and the effects on the stage structure, insulation, and propellant resulting from radiation and cryogenic stresses during a hot-fire cycle

(4) Evaluate stage and engine handling, maintenance, safety, checkout, test procedures, and training of flight-test personnel

(5) Verify S-N stage (RIFT)/IU and RIFT/NERVA interface design

Tertiary

(1) Demonstrate the capability of the nuclear stage systems to fulfill advanced flight-profile requirements by performing flight-type engine shutdown, engine cooldown, and simulated inflight engine restarts.

*Reproduced from "RIFT Integrated Test Plan," NSP-62-05.

1.3.3 Test Specifications

For each firing run, NSP Engineering will generate a test specification document containing the following information:

- Test description
- Test objectives
- Test result need dates
- Prerequisites and contingencies
- Specific requirements on test articles, equipment, and facilities for achieving the desired results in a particular test
- Operational constraints necessary for yielding meaningful results
- Test parameters
- Test data requirements
- Data analysis requirements

The stage preparation, test, and post-test plans contained in Annexes C, D, and E respond to the requirements imposed by test specification documents.

1.3.4 Test Operations Program Plan

This document is a comprehensive presentation of the plans for conducting all RIFT Program test activities. It includes overall test schedules, major test objectives, test responsibilities, facilities, and equipment to be used, working arrangements within LMSC and with external agencies, and resources allocated to the various programs.

1.3.5 Test Directive

This is a formal statement of authority within the LMSC line organization to conduct a given test in accordance with an approved test plan.

1.3.6 RIFT Safety Plan

(Description and provision for implementing is not provided at this time)

1.3.7 RIFT Quality Assurance Plan

(Description and provision for implementing is not provided at this time)

1.3.8 RIFT Reliability Plan

(Description and provision for implementing is not provided at this time)

1.3.9 NRDS Standard Operating Procedures (SOP)

(Description and provision for implementing is not provided at this time)

1.4 ASSUMPTIONS

In the present draft of this plan, most of the statements regarding character of equipment, organizational relationships, and resources available are properly entitled assumptions; no purpose would be served in noting them in detail. In subsequent revisions, when the ratio of established facts to assumptions is considerably higher, the specific assumptions on which the plan is based will be called out. In the interim, the plan as drafted can serve its two major purposes, which are to furnish a statement of tentative long-range planning and to provide a vehicle whereby coordination in many areas may be achieved.

Section 2
THE NUCLEAR ROCKET DEVELOPMENT STATION (NRDS)
(Outlined only)

2.1 GENERAL

2.2 GEOGRAPHY

2.3 EXISTING FACILITIES

2.4 TOPOGRAPHY OF RIFT AREA

2.5 METEOROLOGY

2.6 STATION MANAGEMENT

2.7 SUPPORT SERVICES

2.8 NRDS USER ORGANIZATIONS AND PROGRAMS

2.9 SOUTHERN NEVADA INFORMATION

Section 3
FACILITIES, TEST EQUIPMENT, AND TEST ARTICLES

3.1 FACILITIES

3.1.1 Responsibility for Requirements

LMSC is responsible for stating,to NVPO, requirements for RIFT captive test facilities. Within LMSC, NSP Stage Test is responsible for determining operational and functional requirements that the facilities must satisfy; NSP Systems Integration is responsible for stating requirements for satisfying test objectives; and NSP Support Systems and Facilities Engineering is responsible for conducting studies of facility concepts and for detailing and documenting facility requirements. Inputs from other NSP organizations will be obtained in the course of coordinating this document and those originated by Systems Integration and Support Systems and Facilities Engineering.

3.1.2 Method of Providing Facilities – User Facilities vs. Station Facilities

Facilities needed by LMSC in NRDS will be provided in two different ways. Those to be provided specifically and more or less solely for RIFT operations are called "RIFT User Facilities"; those that LMSC will occupy jointly with other NRDS users or which provide common services for all NRDS users are called "Station Facilities Occupied by RIFT" or "Station Facilities Serving RIFT," as the case may be.

Design and Construction of User Facilities. RIFT User Facilities meeting the requirements approved by NVPO will be designed by an architect-engineer (RIFT AE) under contract to the Facilities Design office (FDO) of MSFC. These designs will be reviewed by NSP Stage Test and by NSP Support Systems and Facilities Engineering to ascertain that they satisfy NSP requirements. The designs will be subject to approval by NVPO and coordination with SNPO-N as prescribed by SNPO. The facilities will be constructed by contractors hired and managed by SNPO-N with the assistance of the NRDS Construction Management Contractor (CMC). Construction will be subject to inspection by the CMC in coordination with the RIFT AE and will be monitored by RIFT NRDS Operations and by project representatives of NSP Support Systems and Facilities Engineering. This monitoring will ensure that design interpretations made in the field are consistent with facility requirements and that updatings of facility designs to conform with approved revisions in facility requirements are introduced in a timely fashion.

The Facilities Liaison Group (FLAG) is established for each FDO-MSFC facility to expedite design and construction field changes. This group consists of the following representatives:

- Architect-Engineer, or Construction Contractors
- The design and/or construction management agency
- Facilities and Design Office, (SNPO-N) MSFC
- The User Organization (LMSC)

It would be the responsibility of the individual representatives to initiate, approve, or disapprove proposed design changes. They provide a single point of contact for this agency or company.

Acceptance and Occupation of User Facilities. SNPO-N will accept the facilities for the government and will establish beneficial occupancy dates. As these dates are reached, RIFT NRDS Operations will occupy RIFT User Facilities and proceed with facility activation and validation as set forth in Annexes A and B to this Operation Plan. Thenceforth RIFT NRDS Operations will be responsible for operation and maintenance of these facilities as provided for in Memoranda of Understanding existing between NVPO and SNPO-N, which will be reflected in the facilities contract under which LMSC operates in NRDS.

Modification of User Facilities. (To be described in later revisions of the Operations Plan.)

User Facility Plant Equipment. Facility requirements documents and RIFT AE facility designs will call out equipment in the plant equipment category as a part of the facility that LMSC will operate and maintain. Unless otherwise stipulated in the facility designs, such equipment will be installed in RIFT facilities during construction, or as otherwise arranged by SNPO-N. In the case of portable facility plant equipment and in the case of facility plant equipment that has an intimate interface with RIFT GSE, RIFT NRDS Operations will be responsible for its installation, and RIFT facility designs will so stipulate. Equipment which is to be called out in facility designs, but is to be furnished by SNPO-N and installed or taken in custody by RIFT NRDS Operations, is referred to in Table 3-1 and is listed in detail in Annex H to this Operations Plan.

Station Facilities. Station facilities will be designed and constructed by SNPO-N to satisfy the aggregate requirements of all NRDS user organizations. Requirements for space in Station Facilities for RIFT occupancy and requirements for Station Facilities to provide services to RIFT NRDS Operations are stated in the NRDS Program Requirements Document that is included as one section of Annex G. The Program Requirements Document makes reference to the detailed descriptions of required common use facilities contained in the NSP facility requirements documentation referred to in Section 3.1.1.

Common Use Plant Equipment. RIFT requirements for use of equipment that is to be drawn from pools maintained by SNPO-N as the need arises are stated in Program Requirements Documents and Operational Requirements Documents contained in Annex G; they are not included in the schedule of equipment in RIFT facility designs referred to under "User Facility Plant Equipment."

3.1.3 Requirements for RIFT NRDS Facilities

General Requirements. General requirements that RIFT NRDS facilities must satisfy to accommodate test hardware, sustain the tempo of operations contemplated in the RIFT Stage Overall Program Plan, cope with the NRDS environment, or facilitate achieving objectives of the RIFT Integrated Test Plan are stated below. These facility requirements reflect mainly an operational point of view. It is intended that they be augmented by the more detailed requirements referenced under "Detailed RIFT User Facility Requirements."

a. The facilities collectively must serve four major purposes:
   - Facilitate stage preparation
   - Harbor and service stages undergoing captive test
   - House personnel and equipment for checkout, test control, and data acquisition
   - Afford space for engineering and administration

b. The facilities must be capable of housing four stages, so that simultaneous preparation work on four stages can be protected from the elements.

c. The facility should be two-sided, with each side capable of supporting the cyclic operations performed on two stages independent of the operations being conducted in the other side. Operations in one half should not interfere with those in the other, except possibly as a result of precautions taken during transportation of a hot stage and during an actual firing test.

d. The facilities should permit full duration firing runs to be conducted one week apart in the same half of the facility. The facilities should also permit partial duration refirings of a given stage on the same stand to be conducted at three-day intervals.

e. The facilities should be designed so that stage test operations will cause minimum interference with stage preparation operations.

f. The facilities must be capable of supporting operations on stages whether radioactive or not. There should be minimum differences in major procedural steps necessitated by the radioactive condition of a stage. In keeping with (c), each half of the facility should be capable of handling a hot stage, independently of the other.

g. The test stands should be so equipped that operations short of extensive repairs (but including especially routine inspections, adjustments, and replacements that must be performed on stages between multiple test runs on a given stage-engine combination)can be performed without removing the stage from the stand. For the purpose of interpreting this requirement, extensive

Table 3-1

FACILITIES, TOOLING, AND GSE REQUIREMENTS

Item	STE & Tool	Item Classification: Facil.	GSE	Other	Rqmt.	Design: Prel.	Final	Acquisition	Installation	Acc. Test	Acc. By	Maint.[1]
1. SAM Building Complex		X			L	M	M	M	M	L	M	L
2. Test Control Center Complex		X			L	M	M	M	M	L	M	L
3. Demating Facility Complex		X			L	M	M	M	M	L	M	L
4. Vehicle Test Stand Complex(es)		X			L	M	M	M	M	L	M	L
5. Site Development & Utilities		X			L	M	M	M	M	L	M	L
6. Portable Ground Power Equipment		X			L	L	L	M	M	L	M	L
7. LH_2 Facility Control Console		X			L	M	M	M	M	L	M	L
8. LH_2 Facility Data Acquisition Sys.		X			L	M	M	M	M	L	M	L
9. Altitude Simulation System Facil.		X			L	M	M	M	M	L	M	L
10. Alt. Sim. Sys. Data Acquis. Sys.		X			L	M	M	M	M	L	M	L
11. Other Facil. System Controls & Acquis.		X			L	M	M	M	M	L	M	L
12. Product Assurance Equipment		X			L	–	–	M	L	L	M	L
13. Secondary Standards Laboratory		X			L	–	–	M	M	M	M	M
14. Std. Portable Test & Calib. Equip.		X			L	–	–	M	L	M	L	L
15. Portable Lighting Equipment		X			L	–	–	M	–	M	L	L
16. Communications Equipment		X			L	–	–	M	L	–	L	L
17. LMSC TWX Tie-Line Transmitter		X			L	–	–	M	L	–	L	L
18. Machine Tools		X			L	–	–	M	L	–	L	L
19. Portable Hand Tools		X			L	–	–	L	–	–	L	L
20. Office Equipment		X			L	–	–	M	L	–	L	L
21. Reproduction Equipment		X			L	–	–	M	L	–	L	L
22. Photographic Equipment		X			L	–	–	M	L	M	L	L
23. General Purpose Vehicles		X			L	–	–	M	–	–	–	M
24. *Manual & Automatic Test Stations*			X		L	L	L	L	L	L	M	L
25. Test Control Console (& Auxiliary Consoles)			X		L	L	L	L	L	L	M	L
26. Data Acquis., Record., & Display System			X		L	L	L	L	L	L	M	L
27. Computer Complex(es)			X		L	L	L	L	L	L	M	L
28. Checkout Control Console(s)			X		L	L	L	L	L	L	M	L
29. Environmental Control Equipment			X		L	L	L	L	L	L	M	L
30. Nuc. Safety Mon. Equipment			X		L	L	L	L	L	L	M	L
31. Non-RIFT Stage Simulators & Interconnects			X		L	L	L	L	L	L	M	L
32. RIFT Stage Simulators			X		L	L	L	L	L	L	M	L
33. Test Umbilicals & Handling & Connection Sys.			X		L	L	L	L	L	L	M	L
34. Prop./Pneu. Ctrl. Equip. (Grd. Svc. Units)[2]			X		L	L	L	L	L	L	M	L
35. Stage Onsite Transporter			X		L	L	L	L	L	L	M	L
36. Engine Installation Vehicle[3]			X		L	–	–	M	–	M	–	–
37. "Hot" Component Transportation			X		L	–	–	M	L	–	L	L
38. Stage Mounting Stands			X		L	L	L	L	L	L	M	L
39. Rocket Handling Dolly			X		L	L	L	L	L	L	M	L
40. Engine Storage & Positioning Stand			X		L	L	L	L	L	L	M	L
41. Flight Umbilicals & Handling & Connection Sys.			X		L	L	L	L	L	L	M	L
42. Umbilical-type Arms				X	L	L	L	L	L	L	M	L
43. PAM FM/FM & SS/FM Ground Stations			X		L	L	L	L	L	L	M	L

(1) LMSC and MSFC maintenance at NRDS will interface with maintenance support by NRDS support services contractor.

(2) Definition of this equipment is set forth in NSP-62-6, Preliminary Facility Requirements for the RIFT Cold-Flow Facility, as revised, and in a letter, M-P&VE-N to LMSC-NSP (LMSC/A332022), dated 21 January 1963.

(3) Furnished and maintained by AGC

repair should be taken to mean any nonroutine work that would require more than a normal work week to accomplish, either on the stand or in the stage preparation facility.

h. The facility should be designed to minimize the number of times that a stage must be relocated during a test cycle.

i. Facilities and test equipment should permit conducting functional checkout of the complete stage both at the stage preparation location and at the test stand.

Concept of RIFT NRDS Facilities. A concept of RIFT NRDS facilities that is consistent with the general requirements stated, and is reported in NSP-64-15, RIFT NRDS Facilities Planning Technical Status Report, is illustrated in Fig. 3-8. It consists of the following major units, with features noted.

a. Stage Preparation Complex consisting of the following:

(1) A Mate-Demate Facility (MDF) with two adjacent hot cells, each capable of housing a complete stage; mating and demating engines on either hot or cold stages; permitting maintenance to be performed remotely or otherwise on the after skirt region of the stage; permitting maintenance of stage equipment in the forward skirt area to be performed with necessary personnel shielding; and permitting engine and integrated stage systems functional checkout to be conducted on a stage located in the cell. The hot cells are designated MDF "A" and MDF "B" in Fig. 3-8.

(2) A Stage Assembly and Maintenance (SAM) bay capable of receiving stage subassemblies on the RIFT Overland Transporter; erecting stage subassemblies; facilitating assembly, modification, and rework of two stage subassemblies simultaneously that are either warm or cold, radiologically; permitting testing and checkout of subsystems, stage systems, and (with simulators) integrated systems; and affording means whereby IU rings, attitude nozzles and stage protective covers may be attached and removed. The two stage assembly and maintenance locations are designated SAM "A" and SAM "B" in Fig. 3-8.

(3) Facilities prescribed by MSFC-Astrionics for IU preparation.

(4) Shops, warehouses, and component test facilities to support stage preparation and ground system maintenance.

(5) Standards Laboratory.

(6) An Operations Monitoring Station for monitoring the site, exercising personnel control, and controlling emergency situations.

Note: Previously documented requirements for RIFT stage preparation facilities contemplate a Stage Assembly and Maintenance (SAM) building and a Demating Facility (DF) located remotely from the SAM. Detailed requirements for these facilities are contained in NSP-62-19 and 62-17. The variation of RIFT NRDS facility concepts described in this document has been under study as is described in NSP-65-15. In the concept described herein, both computer complexes would be located in the stage test control center and only enough office and desk space would be provided in the SAM and MDF for efficient direction of local stage preparation functions. Another facility concept under study has the MDF a part of the STCC. For planning purposes, it is assumed in this document that the SAM and MDF either will be constructed as a single structure or will be located so close as to be considered elements of the same complex.

b. Captive Test Complex consisting of the following:

(1) Two Stage Test Stands (STS), each capable of mounting a stage for captive test; servicing a stage with electric power, pressurized gases, and cryogenic fluids; accommodating GSE needed during countdown, test firing, cooldown, and pretest and post-test checkout; providing the stage with umbilical connections for flight type and NRDS-peculiar test control, test monitoring and data gathering; facilitating operations that must be accomplished by remote methods between firing runs on a stage while it remains on the stand; carrying

away stage exhaust; providing means for photographic and other types of data gathering from the ground during captive tests; facilitating alignment of stage systems; providing means for controlling damage to stage and facilities in the event of fire, reactor excursion, or other casualty; and permitting maintenance of stage systems in the forward skirt area to be carried out with adequate shielding of personnel.

(2) Fluid Storage Area associated with each stand capable of storing the pressurized gases and cryogenic fluids needed for test operations on the stands. One area should also contain a maintenance shop.

(3) A Local Test Station (LTS) at each test stand, located in a shielded enclosure as close to the stage as possible. This station is to house personnel and equipment for conducting tests on stage systems, subsystems, and black boxes, and checkout by manual means, utilizing all electrical and pneumatic access points with which the stage is equipped and utilizing temporary cabling where necessary to obtain access between stage component assemblies. This station would also serve to house equipment used by the automatic checkout and test control system to convert digital orders to analog or on-off signals at a location as close to the stage as possible. During automatic mode of checkout, personnel in this station would only monitor equipment operation. The station would not be manned during test runs.

(4) A Stand Local Control Station (LCS) at each stand for exercising control of and for monitoring the condition of stand facility systems and GSE located at the stand during periods of stand maintenance and stand preparation for test runs. It must be shielded to permit occupancy when a radioactive stage is in the stand. While stand systems are being checked by automatic means, only equipment operation monitoring will be performed in this station.

(5) A Fluid Storage Area Local Control Station at the service area of each stand for monitoring the condition of and controlling the status of the cryogenic storage and pressurized gases storage systems in the area during maintenance periods and during filling operations. The station would not be manned during test runs.

(6) A Stand Headquarters and Support Building near each stand providing offices for first line supervision of Stand Complex operation and maintenance and shop and storage space to support routine work of this nature.

c. STCC (Stage Test Control Center) consisting of underground chambers to provide space for the following:

(1) Two integrated instrumentation systems associated with the two halves of the facility respectively.

(2) Operation of the systems in their various modes of operation.

(3) Shop and storage required for maintenance of electrical GSE.

(4) Office and desks for first line supervision and engineering associated with operation and maintenance of electrical GSE and with conducting tests, checkout, and firings of stages.

(5) Personnel and equipment required for quick-look data reduction.

(6) Official observers of test runs.

Detailed RIFT User Facility Requirements. Detailed facility requirements are contained in the following documents:

- Site Development and Utility Requirements, NSP-62-3
- Stage Assembly and Maintenance Building, NSP-62-19
- Demating Facility Requirements, NSP-62-17
- Stage Static Test Facilities, NSP-62-20
- Service Systems for Vehicle Test Stands, NSP-62-18
- Transporter, NSP-63-82

3.1.4 Operational and Functional Requirements for Station Facilities

Station Facilities Occupied by RIFT. Space will be provided in the NRDS Engineering and Administration Building located in the Central Support Area for the following functions: RIFT NRDS Management, except for first line supervision of operations and maintenance; generally all administrative functions to be performed by RIFT NRDS Operations; and part of the field engineering and base engineering functions to be performed.

Station Facilities Serving RIFT. Facilities of this category that are required can be inferred from the services noted in Section 4.3.4 that it is assumed agencies controlled by the government will provide.

Detailed Requirements for Station Facilities and Equipment. Requirements are found as indicated here:

- Program Requirements Document – Annex G
- Central Support Facilities and Site Utilities – NSP-62-16
- Requirements for Dead Storage of Radioactive Materials, Radioactive Waste Disposal, and Decontamination – NSP-63-73
- Requirements for NRDS Alarm Systems, Site Monitoring, and Emergency Communications – refer to Section 3.1.5

3.1.5 Requirements for NRDS Alarm Systems, Site Monitoring, and Emergency Communications

An alarm, monitoring, and emergency communications system must be provided to monitor all areas for emergency conditions, sound alarms at points from which action can be directed, and provide adequate communications for effectively combating the emergency. The important requirements are summarized here; additional details are in documents referred to under "Detailed RIFT User Facility Requirements" and in NSP-63-73.

Present planning is for two vehicle test stands (STS 4 and STS 5) with separate cryogenic storage and handling facilities at each stand. If there is a third stand, monitoring and alarms associated with it will be essentially the same as for the others. In each test stand area there will be one or more Local Control Stations at which certain operations such as fluid transfer can be controlled if desired. Monitor readouts and alarms necessary for operations and personnel safety in the stand area will be located in the Local Control Station. Selected remote readouts and alarms will be provided in the stage Test Control Center (STCC) as necessary for conducting test operations and in the Operations Monitoring Station and Central Support Area (CSA) as necessary for safe and efficient operation.

The STCC will be connected to the test stands by a tunnel and will be the point from which the captive tests are controlled. Readouts and alarms from monitoring systems at STS 4, STS 5 and STCC will be located on the Facilities Control Console and the Health Physics Console with selected remote readouts and alarms in the Operations Monitoring Station and the Central Support Area (CSA) as necessary for safe operation.

All readouts and alarms for monitors in the Mate Demate Facility (MDF) will be located on the MDF Master Control Console, with selected remote readouts and alarms in Operations Monitoring Station and CSA as necessary for safe operation.

An Operations Monitoring Station will be located in or near SAM, and will function as the nerve center for the RIFT site. Readouts and alarms from each of the RIFT facility areas will be located here. Readouts and alarms needed in the Central Support Area (CSA) will be connected by hardlines from this station to the CSA.

<u>3.1.5.1 Systems.</u> Status warning lights (different colors, flashing, steady) will be used in each area and building to indicate whether the area is safe. These will be located at the area boundaries, gates, building entrances, and exits, and at strategic locations within the areas and buildings.

The hazards and approach alarm will be sounded in an area to indicate an approaching hazard or potential hazard such as a hot stage or engine on the transporter. It will be initiated from the control console in the building located in the area affected.

There will be the normal telephone system, which will be a conventional system, as well as the emergency and operational safety communications systems.

Personnel control will be primarily procedural, using work permits, logs, locked doors and gates, and headcounts. The evacuation alert will be sounded via the PA system. Fire, hydrogen, radiation and criticality monitoring will be provided as discussed.

3.1.5.3 Alerting and Public Announcing (PA) System. Figure 3-1 shows the zones covered by the speakers, stations having microphones, and the zones to which each station has access. Zone selections will be by switches located at each station. If the emergency alerting switch is thrown, a distinct signal is sounded in all zones to be followed by a message from the station originating the alert. For reliability, separate cables are used for transmitting the emergency alert.

The evacuation signal will also use the PA system. Each station will be able to sound an evacuation signal in any or all of the zones to which it has access.

3.1.5.3 Hot Line Phone System. A hot line phone system will be used for emergency communication within the RIFT Complex (Fig. 3-2). This system will tie the RIFT Base Manager, Operations Monitoring Station, MDF, STCC, STS-4, and STS-5 together. When any of the phones are picked up, all others will ring continuously until answered.

A similar system will be available for emergency communication between the RIFT, NERVA, ROVER, and SNPO-N Base Managers.

Stations / Access	STCC Zone	STS 4 Zone	STS 5 Zone	Mate-Demate Zone	SAM Zone	Cryo Gas Zone	Fill Sta. Zone	CSA Zone	All Zones	Emergency Alerting
STCC	X	X	X			X	X		X	X
STS-4		X								
STS-5			X							
Mate-Demate				X					X	X
SAM					X				X	X
Operations Monitoring Sta.	X	X	X	X	X	X	X	X	X	X
Cryo Gas						X	X			
Fill Sta.						X	X			
RIFT Base Mgr.	X			X	X			X	X	X

Fig. 3-1 Alerting and Public Address System

NSP 6876

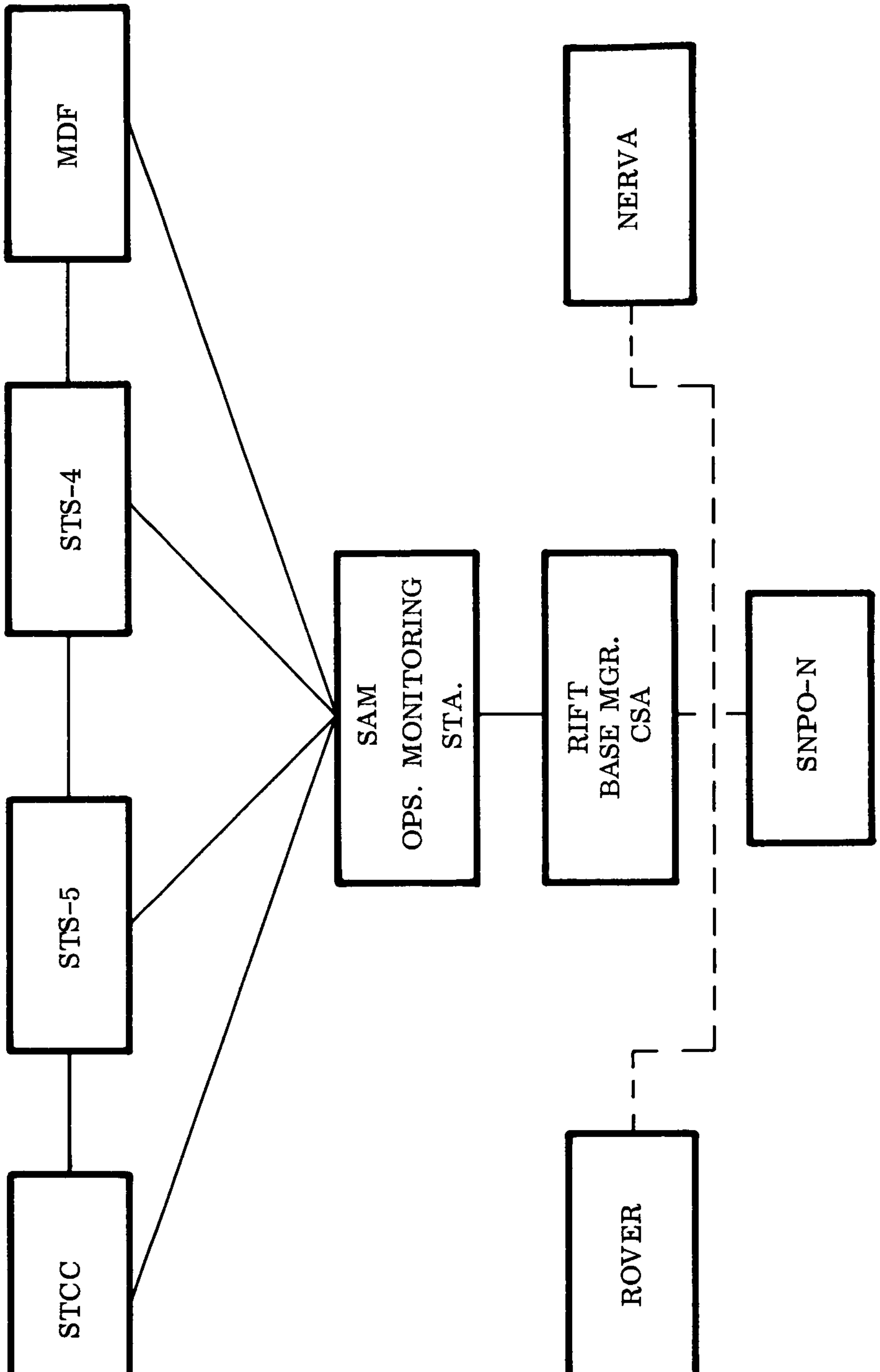


Fig. 3-2 Hot Line Phone System

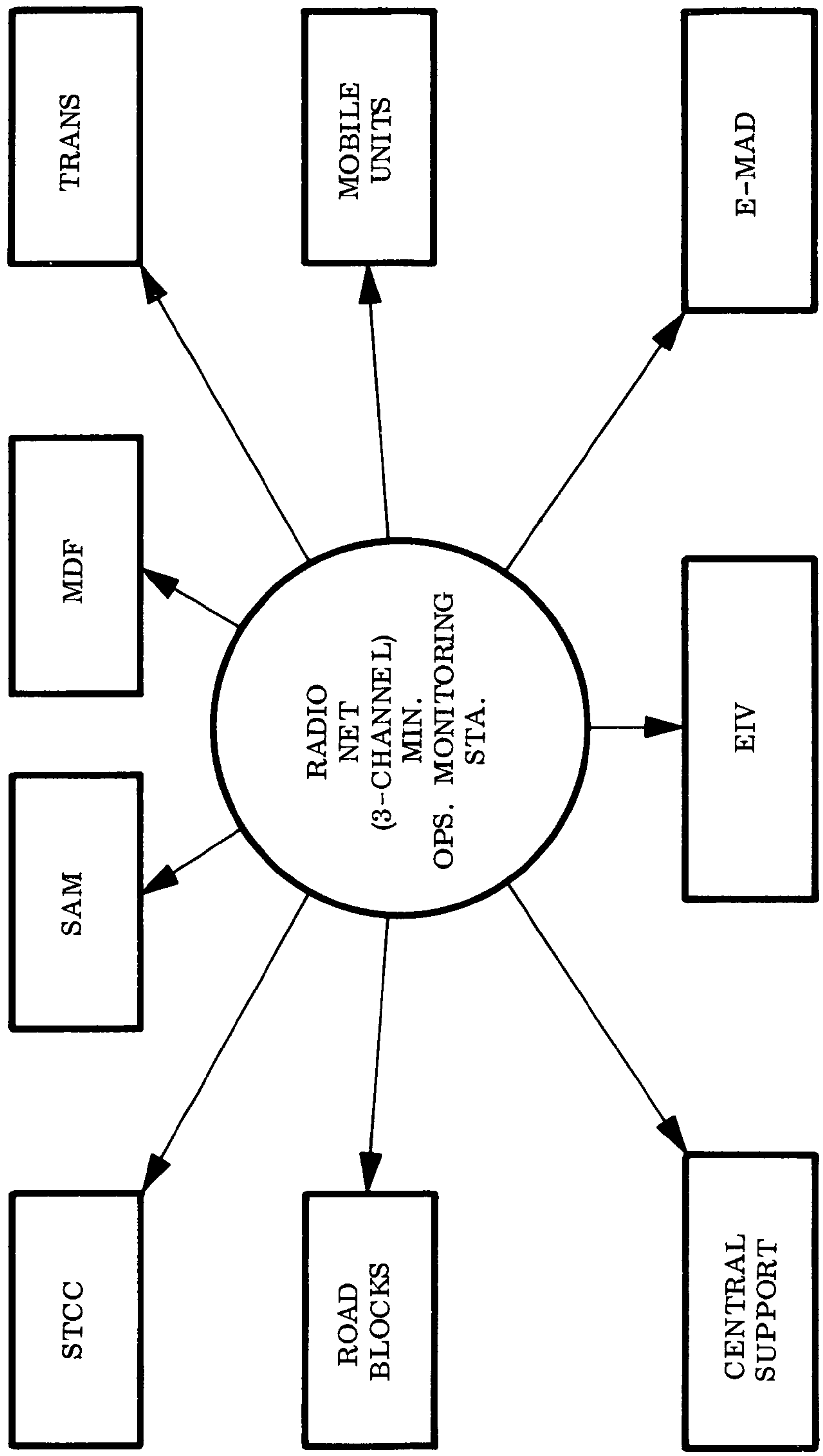
NSP 6877

3.1.5.4 Radio Net. A three-channel-minimum radio net will be provided primarily for communication between the Engine Installation Vehicle (EIV) and Stage Transporter and the facilities directing their movement (Fig. 3-3). One channel will be used for communicating with the EIV and the Engine Maintenance Assembly and Disassembly Building (E-MAD) during engine transfer; one channel will be used for communications between SAM, MDF, STCC, and the Stage Transporter during stage transfer; a third channel will serve as backup for the other two. These three channels, or additional ones, will be used for communication with other mobile vehicles and road blocks in the RIFT area.

3.1.5.5 Fire Detection and Alarm System. The system will meet LMSC, NRDS, and National Codes and Regulations. Fire sensors or pull boxes will be located in all areas, with alarms connected as shown in Fig. 3-4. Besides alarms in the immediate vicinity of the sensor or box; STS-4 and STS-5 areas will alarm the Stand Local Control Station, STCC, Operations Monitoring Station and CSA; STCC area will alarm in STCC, Operations Monitoring Station and CSA; MDF area will alarm in MDF, Operations Monitoring Station, and CSA; SAM area will alarm in Operations Monitoring Station and CSA. Alarms in STCC, Operations Monitoring Station and MDF will be at the control consoles in each building.

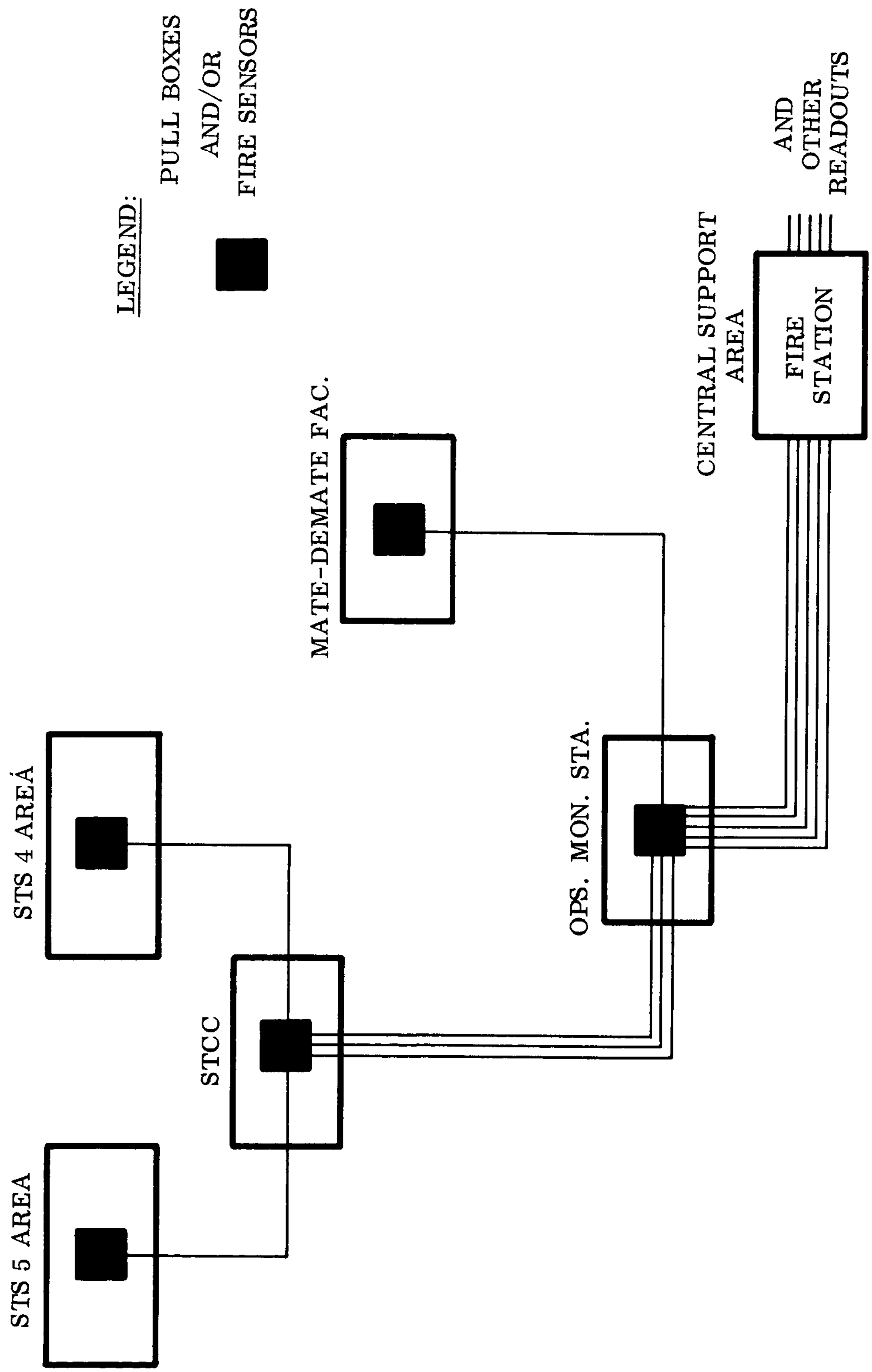
3.1.5.6 Hydrogen Leak Detection System. It is planned that within the RIFT area, hydrogen will be handled and stored only in STS-4 and STS-5 areas. Each detector will read out and alarm at the Stand Local Control Station located in the area, and detectors at each stand will also read out and alarm in STCC (Fig. 3-5). A single alarm located in SAM will sound when any of the channels alarm. This alarm can be extended to the CSA to provide alarm coverage when the RIFT site is not occupied.

3.1.5.7 RIFT Area Radiation Monitoring System. This system will provide information to determine whether the areas are safe for personnel occupancy and will alarm when a dangerous level is reached. Detectors are located throughout the areas and buildings and on the air intake to each building as indicated in Fig. 3-6. The Stage Transporter will have readouts and alarms in the cab and will also telemeter important readings to SAM and STCC.



NSP 6878

Fig. 3-3 Radio Net



NSP 6879

Fig. 3-4 Fire Detection and Alarm System

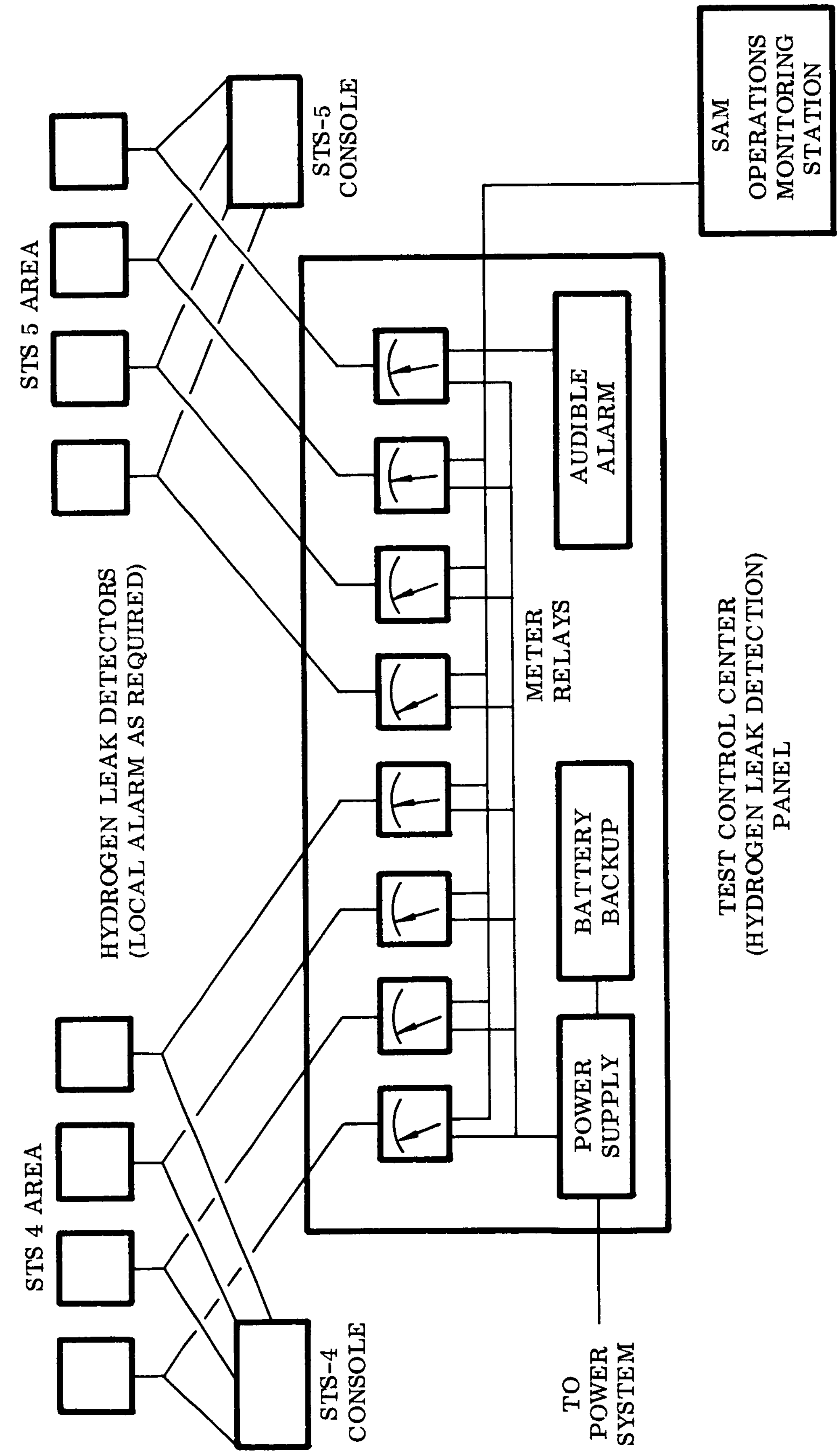
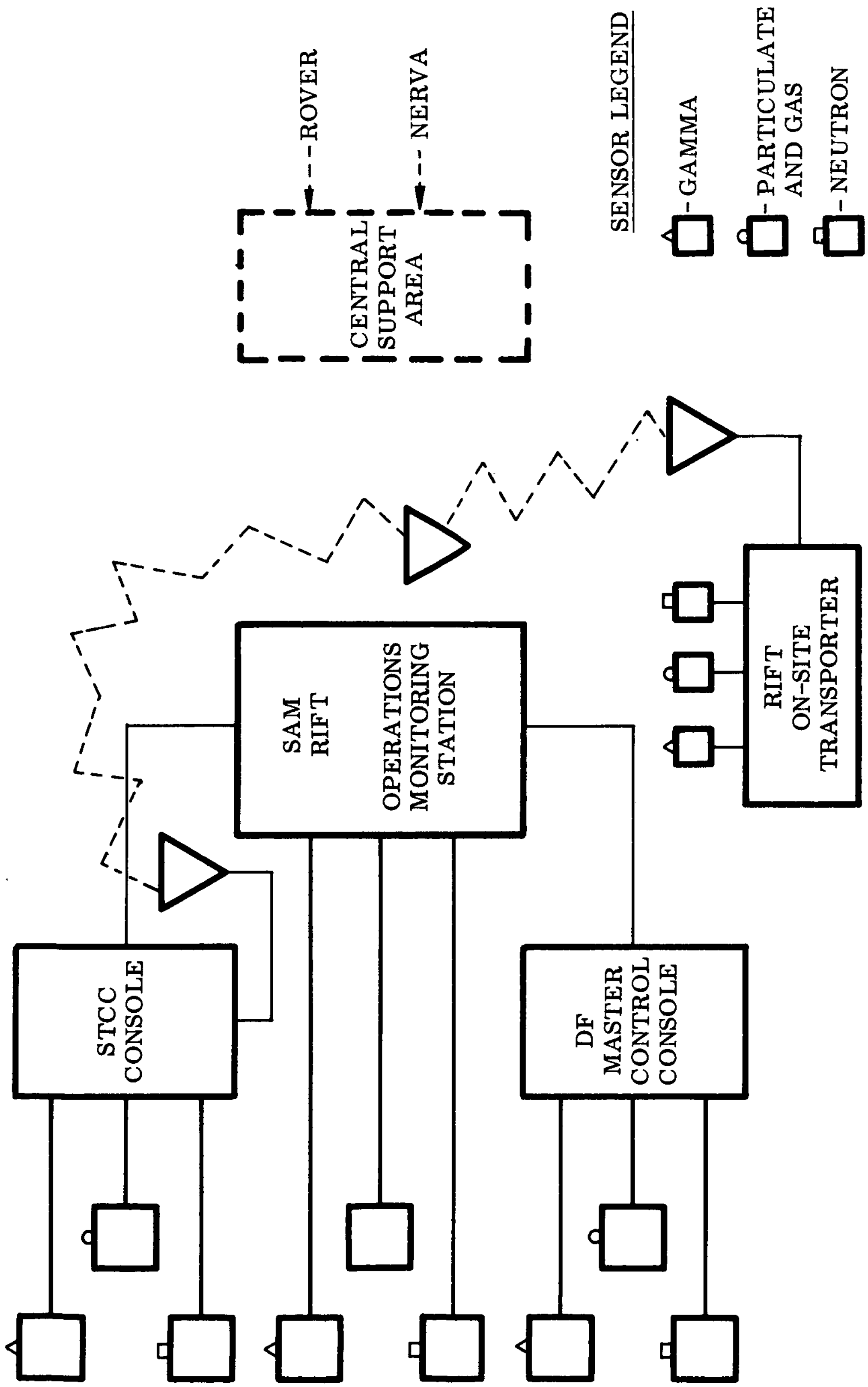


Fig. 3-5 Hydrogen Leak Detection System

NSP 6880



NSP 6881

Fig. 3-6 RIFT Area Radiation Monitoring System

Detectors in the test stand and STCC areas have local alarms and alarm and readouts at the Stand Local Control Station and the STCC Health Physics Console. Selected readouts and all alarms are also transmitted by hardline to the Operations Monitoring Station. Detectors in the MDF area will also have local alarms and alarm and readout on the MDF Master Control Console with selected readouts and all alarms transmitted to the Operations Monitoring Station. Detectors in SAM area will have local alarms with readout and alarm in the Operations Monitoring Station.

Selected readouts and alarms from the Operations Monitoring Station will be transmitted to the CSA.

3.1.5.8 Criticality Detection and Alarm System. This system will monitor all areas for engine criticality where a live engine will be handled or stored. All areas that will be directly affected by criticality will be alarmed by the sensors located in the area of criticality (Fig. 3-7). Remote readout and alarms will be connected as described for the Radiation Monitoring System.

3.2 ELECTRICAL TEST EQUIPMENT

3.2.1 General Requirements

NRDS Electrical GSE must be designed so that stage qualification tests can be performed with maximum possible similitude with J. F. Kennedy Space Center launch operations. For stage qualification testing, the GSE must implement the MSFC Automation Plan and be capable of conducting the multiplicity of checks on an article under test, and on itself, with the frequency and rigorous, repeatable reliability characteristic of automatic systems. At the same time, the GSE must be designed so that stage diagnostic testing can be performed to further stage design improvement and so that early testing may be conducted before automatic test equipment and computer programs have been completely perfected.

For diagnostic and development phase testing, the GSE must provide the means whereby human judgment and analytic power can best be utilized to respond to the unforeseen,

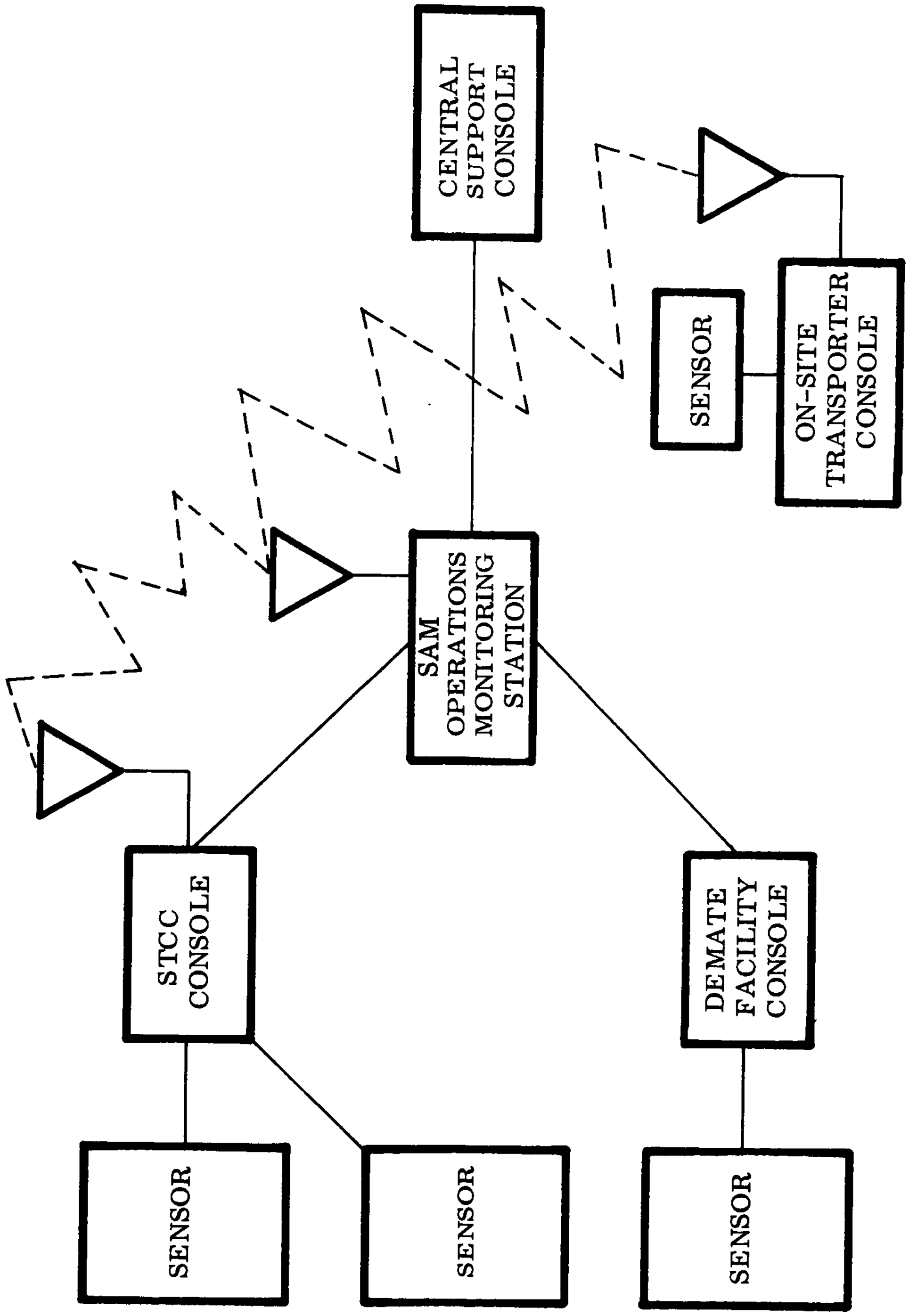


Fig. 3-7 Criticality Detection and Alarm System

NSP 6882

and determine the cause. Where superhuman response times are necessary, however, automation must be provided. The design of GSE should proceed on the assumption that, in the RIFT NRDS program, each time the GSE is utilized to aid in performing a checkout or a test run, the test article will be configured differently. Perhaps the change will be slight on most occasions, but on others it will differ in a large number of important ways. It should be recognized that only where human intelligence can influence the functioning of GSE will it have any degree of flexible application. Contrariwise, only where human volition is excluded, will it have rigid, mechanical repeatability. Since both attributes are needed, it is important that the system exploit both manual and automated modes of operation.

3.2.2 Influence of Facility Design

Facility requirements referred to in Section 3.1 include space requirements for housing electrical GSE. The configuration that the facilities will actually take will depend upon how the facility designer interprets the requirements. Yet the configuration that the facilities will have will influence the arrangement and in some respects the characteristics of useful GSE. For purposes of stating operational requirements for GSE, it will be assumed that NRDS facilities take the form described under "Concept of RIFT NRDS Facilities," and that the functions set forth in Section 5.2 will be performed in the different facilities.

3.2.3 Function of Electrical Equipment

Electrical equipment (i. e., electrical GSE, together with electrical facility equipment used in checkout and test)is needed at NRDS to facilitate performing the following functions:

a. Functional checkout of RIFT stage subassemblies, while they are in the SAM building, to determine that stage systems susceptible to checking with electrical equipment have survived either transportation to NRDS or a previous test cycle, as the case may be, and that repairs, modifications, or adjustments that may have been made to such systems are satisfactory.

b. Isolation of faults in stage subassemblies in the SAM building down to the level of units for which replacements are provided as RIFT spares or to units that are repairable in the field.

c. Diagnostic testing in the SAM building of malfunctioning, suspicious, or newly received RIFT stage hardware embracing a yet-to-be-defined set of components, blackboxes, and subsystems. (This differs from checkout or fault isolation in that, where the object of these latter operations is to determine go, no-go answers to tests against specifications, the object of diagnostic testing is to determine the cause of some puzzling behavior, presumably some behavior not circumscribed adequately by existing specifications.)

d. Bench checkout, in the SAM building, of detachable stage parts prior to assembly or reassembly in the stage.

e. Same as a., b., c., and d., for the S-V-N Instrument Unit (IU) in the IU preparation area, as specified and provided by MSFC.

f. Functional checkout of NERVA engines in the MDF.

g. Full systems functional checkout of RIFT stages in the MDF, with or without IU attached.

h. Fault isolation in integrated RIFT stages in the MDF, to the extent of determining whether engine, stage subassembly, or IU is faulty, and to the extent of identifying faulty units of the stage subassembly, engine, and IU that can be replaced or repaired in the MDF while the engine and IU are mated with the stage subassembly, assuming a radiologically cold stage.

i. Full systems functional checkout from the STCC of RIFT stages in the STS, with or without NERVA engines and with or without IU's attached.

j. Fault isolation in RIFT stages in the STS from STS local test station, to the extent of identifying as faulty those units of the engine, stage, or IU that can be replaced or repaired at the STS, assuming a radiologically cold stage.

k. Functional checkout from the STCC of ground equipment affecting conduct or results of captive firing or cold soak tests. (The ground equipment referred to here includes stand equipment, stage service systems, ground instrumentation and optical equipment, special safety equipment, stage and ground control equipment, data acquisition and display equipment, electrical power generation equipment, fluid storage systems, and checkout equipment itself.)

l. Diagnostic and fault isolation testing of ground equipment from stations generally local to the equipment in question.

m. Exercising control from the STCC of the functioning of stages on the STS (with or without engines and with or without IU's) and of the coordinated functioning of STS ground equipment required during cold soak and captive test sequences.

n. Monitoring visual displays in the STCC indicating status and performance of stages and STS ground equipment as necessary to exercise manual control of stage and ground systems.

o. Viewing the stage and STS ground equipment, including the engine cell interior, remotely in the STCC by closed circuit television, with appropriate pan and zoom controls.

p. Recording test data derived from RF flight data channels, launch umbilical data channels, test umbilical data channels, and ground instrumentation.

q. Performing real time computations to aid the function of test control in the STCC.

r. Reducing test data and analyzing test data off line to the extent required to prepare quick-look reports and to evaluate the satisfactory performance of instrumentation and control apparatus.

s. Remote or direct viewing from STS local control rooms of operations to be performed in a radioactive environment, including removal and replacement of stages, duct repair, stand maintenance between runs, stand decontamination, and repairing or adjusting stage equipment in the forward stage bay.

t. Remote or direct viewing, from the MDF control rooms, of operations to be performed in the MDF in a radioactive environment.

u. During ground equipment maintenance periods, controlling and monitoring fluid storage equipment, electrical power equipment, and stand equipment from local stations.

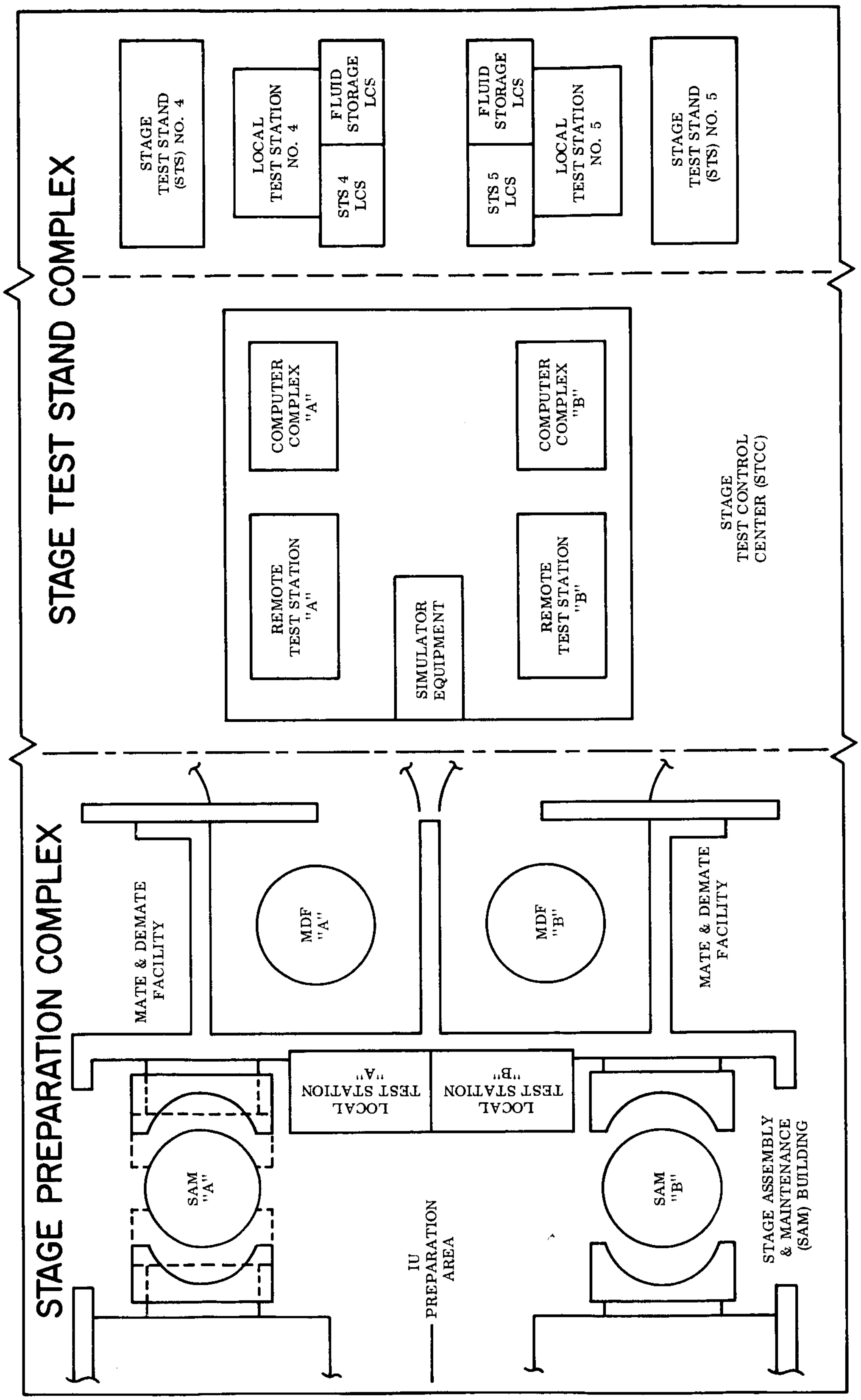
3.2.4 Compartmentation Requirements

NRDS electrical test equipment must be compartmented to satisfy three criteria:

- In keeping with the two-sided character of the facility (i.e., two test stands, two MDF cells, and two SAM preparation stands) electrical test equipment should be compartmented so as to support checkout and test in either half of the facility without interfering with operations in the other half. Data systems may share some equipment, but control systems for the two halves of the facility must be completely separate. Provision should also be made to use elements in one half of the system to augment the capabilities of the other half or to substitute for any elements in the other half that become inoperative.
- Equipment should be compartmented so that, in each half of the facility, the equipment can support either stage preparation operations in the SAM/MDF complex or stage test operations in the STS complex.
- The equipment must be compartmented between local and remote stations. Fault isolation, diagnostic testing, and control and monitoring during maintenance periods should be done from local stations, where access to analog data is possible and special test leads may be run as required. Captive test and cold soak test control and monitoring, data recording, and automatic checkout should be done from remote stations to satisfy either safety or space requirements. Figure 3-8 illustrates an arrangement of equipment that is satisfactory from the operational point of view.

3.2.5 Operational Requirements

The following requirements for NRDS electrical test equipment reflect mainly an operational point of view; by themselves, they are not completely determinant. It is intended that they augment and emphasize requirements documented in the RIFT Requirements Document. Operational requirements follow separately for each of the major functions that the equipment is to serve. Figure 3-9 shows a system that would fulfill these requirements.



NSP 6883

Fig. 3-8 Electrical Test Equipment Arrangement

Requirements for Equipment for Performing Functional Checkout in SAM or MDF. Functional checkout is a series of tests having the following attributes:

- Artificial stimuli are used to excite functioning of the test article in lieu of or in addition to the stimuli that the article actually receives when it is operated in its intended manner.
- For each condition thus imposed on the test article, limits are stipulated for the value of each quantity measured.
- The measured values of parameters of interest for each test article condition are compared with stipulated limits. If they fall within limits, the test is successful and the next in the series is performed; if not, the test article fails to check out.
- In cases where dynamic or transient attributes rather than static ones must be checked against specifications, either a time-varying condition is impressed and a set of limiting acceptable time varying responses are calculated and compared with measured responses to determine that the measured time varying response falls everywhere between the time varying limits, or the time-varying measured response is analyzed for such attributes as rise time, frequency, and phase shift, and these derived quantities are compared with calculated limits of these for the particular time-varying condition impressed upon the test article. In practice, only predetermined and rather special types of time-varying conditions can be employed if the check is not to be delayed while complicated calculations are carried out.
- In a functional checkout, only those parameters are measured which must be in order to indicate satisfactory functioning of the test article. In general, functional checkout, as used herein, does not identify faulty components and does not yield failure prediction information.

Equipment and procedures for performing functional checkout in SAM and MDF should parallel as closely as possible those used for performing checkout in the NAB at the J. F. Kennedy Space Center. To have the required assurance that test stages are functionally ready for transporting elsewhere in NRDS, it must be possible to perform functional checkouts both in the SAM and in the MDF.

There is no requirement based on consideration of NRDS operations alone that functional checkout in SAM or MDF be computer controlled, but the assumption is made that it will be, by virtue of the similitude requirement. Notwithstanding the provision of computer controllable equipment for performing functional checkout in the SAM and MDF, a requirement exists that manual conduct of functional checkout be possible from local test stations serving SAM and MDF. The capability to conduct manual checkout is necessary first as a backup in the event automatic equipment is not operative or is not usable with incompletely configured test stages early in the captive test program and second as a means whereby an ultimate determination may be made as to whether a failure to check out has resulted from a fault in the stage or from some fault in automatic equipment programming or interface equipment functioning.

In consequence of the second of the abovementioned purposes of manual checkout equipment, there is a requirement that the automatic equipment be capable of operating in a computer-prompter mode. In this mode, stimuli are applied and stage controls are positioned manually from local test stations as in manual checkout, but measurements of stage response are received by the computer, and the computer -- which is manually sequenced through its program from the local test station -- signals to displays at the local test station the magnitudes of stimuli and the settings of stage controls that the computer program requires for each step in the checkout.

For manual conduct of functional checkout, the local test stations must be provided with readout instruments, stimuli application switches and controls, and stage controls. Additionally, stimuli and controls must be capable of being governed by computer commands for automatic mode operations. Local test stations must be capable of interrogating DDAS equipment for local display of cable-telemetered data measurements. While not a firm requirement for SAM or MDF checkout, it would be convenient also for the local test station to be capable of interrogating the computer for manipulated and derived data based on that received by the computer through the DDAS.

To conduct checkout of the stage subassembly without engine or IU, and to conduct engine checkout before mating and in order to isolate faults to the subassembly level (i.e., stage, engine, or IU) several interface substitutes are required. The following are convenient designations:

IU SIS	Instrument Unit Stage Interface Substitute, which presents an IU-like interface to the stage
SN IUIS	Stage Instrument Unit Interface Substitute, which presents a stage-like interface to the IU.
SN EIS	Stage Engine Interface Substitute, which presents a stage-like interface to the engine, including engine controller.
SN LSIS	Stage Lower Stage Interface Substitute which presents a stage-like interface to the Lower Stage Simulator.
Eng. SIS	Engine Stage Interface Substitute which presents an engine-like and engine controller-like interface to the stage.
LS SIS	Lower Stage Stage Interface Substitute which presents a lower stage-like interface to the SN stage.

To check out the checkout equipment, additional simulation equipment is necessary. Designations for it follow:

IU TSIS	Instrument Unit Test Station Interface Substitute, which presents an IU-like interface to the remote test station.
SN TSIS	Stage Test Station Interface Substitute, which presents a stage-like interface to the remote test station.

So that necessary internal consistency is provided between incoming and outgoing signals across an interface substitute, and so that transfer functions within the device are operative, the interface substitutes must be linked to a device simulator. Simulators are required for the IU, the stage subassembly, the engine, and the lower stages. It is required that these simulators be controllable both manually and by computer command. The purpose of providing external control over the simulator is to endow it with flexibility of response so that simulation can be generated over a range of imposed conditions.

There is a requirement that a separate set of simulation equipment be provided for each stage that is to be delivered to NRDS, so that a stage and its simulation equipment can be updated concurrently without interfering with operations with other stages. There is also a requirement that one set of simulation equipment suffice for operations with a given stage wherever it may be in the facility. This requirement precludes the necessity of keeping more than one set of simulation equipment updated to any single stage.

Connections that apply artificial electric stimuli to the stage from ground power during checkout should be fused at the local test station.

Requirements for Diagnostic Testing and Fault Isolation in SAM and MDF. The primary requirement for performing these functions is that the local test station be located where short-length test leads and special test cable harnesses can be run to places in the test article that will allow leads and cables to be connected to subsystems and components. Local test stations should be equipped with patch boards between temporary test lead terminations and general purpose excitation and measuring equipment that is provided at the test station for diagnostic and fault isolation testing.

To the extent possible without compromising flexibility, local test station equipment used for functional checkout should also serve diagnostic and fault isolation testing. Interface substitute equipment should be designed to have flexible application for diagnostic and isolation testing.

Bench test equipment will be needed in SAM for diagnostic testing of removable elements.

The assumption is made that automatic fault isolation or programmed diagnostic testing will not regularly be employed in NRDS operations.

STS Functional Checkout. Requirements for equipment for performing pre-flight and post-firing functional checkout and pre-cold soak functional checkout while the stage is on an STS are the same as those in SAM or MDF, except for the following:

- Checkout must be performable remotely from the STCC as well as from the local test station.
- Automatic checkout equipment is needed so that checkout may be performed at the last possible moment before committing a stage to a firing test.

<u>STS Fault Isolation and Diagnostic Testing.</u> Requirements for fault isolation and diagnostic testing while a stage is in the STS are the same as those in SAM and MDF, except that fault isolation is required only where units are replaceable or repairable while the stage is on the test stand. (See Section 3.4 for replaceable and repairable stage components.)

<u>Requirements for Conducting Captive Test Firing.</u> From the time that hydrogen purge begins, remote control of the countdown, test firing, and cooldown countaway operations, prior to shutoff of cooldown hydrogen and nitrogen inerting, must be from the STCC. Where it is possible to do so with reasonable personnel safety, provisions should be made for emergency manual operation of certain local controls to add assurance that the stage can be returned to a safe condition.

Controllable elements in the stage fall into one or more of the following categories. Requirements for ground control equipment are stated for each category.

- Elements that are influenced through a switching matrix in the stage by a digitally encoded command originating in the ground system. Such elements should be controllable during checkout or electrical calibration of data channels from local control stations or from the STCC, either by manual setting of a digital word or by computer-originated command. Where such elements must be controlled during firing runs, they should also be controllable by manual operation of switches or manual settings of dials that are individually identified with the controllable stage element that they influence. In some cases they should also be subject to test sequence command.
- Elements controlled by control loops that are partially ground based. Such control loops, which include those completed through ground-based simulators, should be subject to manual on-off or analog control signals introduced either at local control stations or in the STCC. Provision should be made for slaving the manual controls to computer command for automatic checkout or to test sequencer command for automatic test sequencing.

- Elements provided specifically for conducting prefiring or post-firing countdown and countaway sequences such as fill and drain. Such elements, which need not be controllable during flight, should be manually controllable at both local and remote control stations. Provision should be made for slaving the STCC manual controls to computer or sequencer commands.
- Elements normally controlled by stage control systems, but which are equipped with overrides for emergency control. The overrides for such elements should be controllable manually from the STCC, through direct connection to the stage. Provision should be made to permit the manual controls to be slaved permissively to computer and test sequencer commands.

Controllable elements in the test stand systems, stage service system GSE, and fluid storage systems should be controllable manually from local control stations. Such of these elements as must be controlled during countdown, firing, or countaway should also be controllable manually in the STCC. Provision should be made for slaving these controls to computer or test sequencer commands.

Data of the following categories should be transmitted directly by individual hardline data channels from transducers that are either NRDS peculiar or are redundant to those in the launch pad and flight multiplexed data systems:

- Indications of safe conditions during countdown prior to captive test firing, during test firing, and during the cooldown countaway.
- Data of critical importance for deriving captive test results.
- Data channels on which transients would provide diagnostic information in the event malfunctions occur.
- Information needed to make real time decisions during a captive test run.
- Data needed to draft meaningful flash reports.
- Spot check verifications of flight data channels.

Data in the first and fourth categories above should be displayed in the test control console area. All above channels should be recorded individually, converted to digital language, and made accessible to the checkout computer. Flight data system data should be received and recorded during captive test using the same type of equipment as that to be used during actual flight tests.

Launch pad checkout data should be transmitted and operated upon during prefiring checkout at NRDS in a manner approximating that which is used in preflight checkout at J. F. Kennedy Space Center. The similitude will be only approximate, however, because RIFT GSE will be used at NRDS, whereas Saturn common and probably site peculiar equipment will be used at J. F. Kennedy Space Center. Consequently, the overriding requirement for NRDS is that, in order to conserve equipment and simplify test operations, prefiring checkout should use the same remote equipment as is used for stage preparation checkout.

There is a requirement that the captive test sequence include flight umbilical disconnect. Consequently at least some captive tests must be conducted without flight umbilical connections. As a result, an operational requirement exists for test umbilicals needed for test control and monitoring, for acquisition of NRDS peculiar data, and for providing the redundant data.

A requirement exists for real-time computer operation during captive test runs for passive stage functioning checkout. This means a mode of operation in which the computer though deprived of control of the stage, and of course not able to impose artificial stimuli for purposes of making checks, nevertheless receives data from test umbilicals (and the flight data system if practical), analyzes stage behavior for internal consistency and consistency with conditions imposed by environment and test control actions, and displays for test control purposes the results of its checks.

Stage, GSE, and stand controls having timing or correct settings essential for safety or for achieving primary test objectives should be coordinated, interlocked, and protected by a special purpose event sequencer performing the following functions:

- When a major event in the test sequence is initiated by manual action or by computer command, the device should cause controllable elements in the stage, engine, IU, GSE, and test stand to be actuated as necessary to execute the major event.
- The device should operate as an interlock to make manual controls as foolproof as possible.
- The device should automatically return the stage and stand to a safe condition in the event that special safe condition sensors give out-of-limit signals.
- Provision should be made whereby the computer also can initiate the return to safe condition sequence in the event that its passive checkout analysis indicates that safe limits are about to be exceeded or that primary test objectives are not being achieved.

Maintenance of Ground Equipment. Local stations should be configured and equipped to permit diagnostic testing and local checkout of ground equipment in connection with repair, modification, and maintenance of the test facility and installed GSE.

3.3 OTHER GSE

3.3.1 On-Site Transporter Requirements

(Known requirements are stated in NSP-62-46.)

3.3.2 Handling Equipment

(Known requirements are stated in NSP-62-46.)

3.3.3 Alignment Equipment

(Not provided at this time.)

3.3.4 Leak Check Equipment

(Not provided at this time.)

3.3.5 Scaffolding; Weather Protection, Etc.

(Not provided at this time.)

3.3.6 Optical Equipment Requirements

(Not provided at this time.)

3.3.7 Special Safety Equipment Requirements

(Not provided at this time.)

3.3.8 Communications Equipment Requirements

Intrastation Operational Intercom System. The Intrastation Operational Intercom system provides the LMSC/NRDS facilities with the capability of monitoring and directing individual activities and, at the same time, interfaces these activities with other installations.

The operational intercom system consists primarily of 34 networks (Figs. 3-10 and 3-11) that can be selected as desired at the individual stations where they are terminated. Four networks (Nets 1 through 4) will be designated as common networks throughout the entire LMSC area and will also be terminated to the EMAD area of

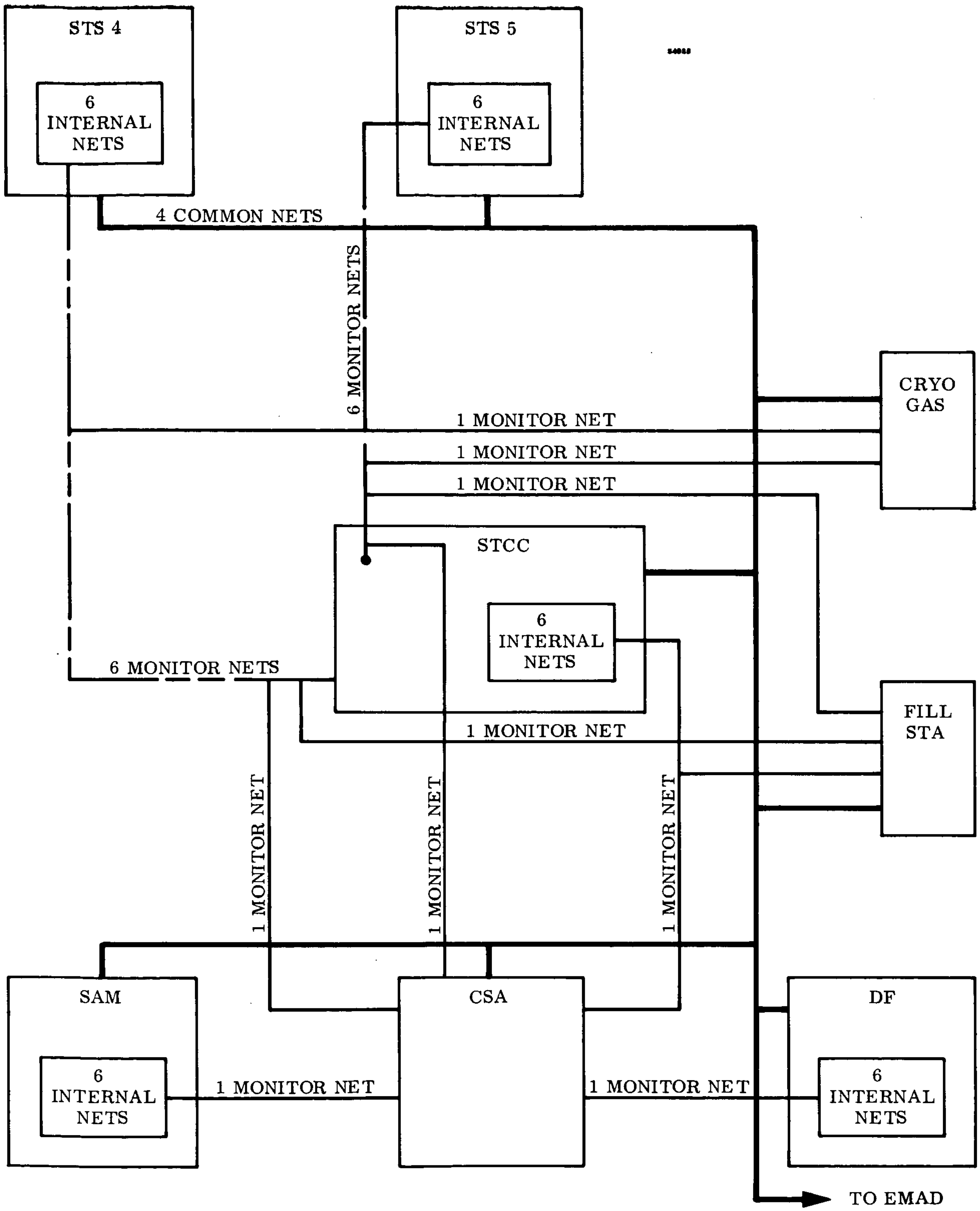


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Fig. 3-10 Typical Intercom Network

Fig. 3-11 Typical Network Utilization

NETS	STS 4	STS 5	STCC	EMAD	DF	CSA	CRYO GAS STA.	FILL STA.	SAM
1	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X
5	X		X			X	X	X	
6	X		X						
7	X		X						
8	X		X						
9	X		X						
10	X		X						
11		X	X			X	X	X	
12		X	X						
13		X	X						
14		X	X						
15		X	X						
16		X	X						
17					X	X			
18					X				
19					X				
20					X				
21					X				
22					X				
23						X			X
24									X
25									X
26									X
27									X
28									X
29			X			X			
30			X						
31			X						
32			X						
33			X						
34			X						
	24 NET CAPACITY 10 NETS USED	24 NET CAPACITY 10 NETS USED	(2) 24 NET PANELS 28 NETS USED	10 NET CAPACITY 4 NETS USED	24 NET CAPACITY 10 NETS USED	24 NET CAPACITY 10 NETS USED	10 NET CAPACITY 7 NETS USED	10 NET CAPACITY 7 NETS USED	24 NET CAPACITY 10 NETS USED

Fig. 3-11 Typical Network Utilization

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AGC/WANL. These four can be used by working together or can be used on an individual basis between stations. One of the four nets (preferably Net 4) will be designated as an emergency net to provide immediate communications between all emergency activities.

Six internal nets will be provided for each major facility (STS 4, STS 5, STCC, SAM, and the Demating Facility). One of the internal nets from each facility will be extended to the CSA area for monitoring and control purposes if desired. In addition, the Fill Station and Cryogenic Gas Storage Area will have access to one of the internal nets serving each test stand which in turn is terminated at a console in the STCC. The six internal nets provided for each of the three major locations (STCC, SAM, and Demating) will have one net connected through to the CSA for direct monitoring and control if desired.

The communications networks requirements for each of the major facilities are as follows:

- CSA – 10-net capability, with one direct net to SAM, Demating, STCC, STS 4, and STS 5, and four common nets that will interconnect with all LMSC facilities and the EMAD.
- SAM – Six internal nets, one of which will be connected through to the CSA for monitoring purposes, plus four LMSC common nets.
- DF – Six internal nets, one of which will be connected through to the CSA for monitoring, plus four LMSC common nets.
- STCC – Six internal STCC nets, one of which will connect to the CSA for monitoring, six internal STCC nets to each test stand, one of which will be available to the cryogenic gas and storage area and fill station and the four LMSC common nets.
- STS 4, and 5 – Will have six internal nets, each of which will be accessible in the STCC; one of these nets will be connected through to the Fill Station and the Cryogenic Storage Area. In addition, each test stand will have the four LMSC common nets available for their use.

- Cryogenic Gas Storage and Fill Station will have access to one of the internal nets provided for each test stand, plus four LMSC common nets.

With this network arrangement, all stations will be able to talk to each other on the four common nets, plus interfacing with each other on common nets pertaining to their functional activities. The location, type, and number of communication panels required at each facility will be provided as operational requirements become more clearly defined.

3.4 TEST ARTICLES

Test operational requirements on design of test stages should be minimized to impose only those essential to conduct ground test operations or that can satisfy without compromising flight characteristics. As noted also in Section 3.2, the requirements stated in this document include only those that stem particularly from the test operational point of view.

3.4.1 Configuration of Captive Test Stages

There is a requirement that RIFT stages, particularly the first captive test stage, be completely assembled and checked out in a ready to be test-fired configuration prior to shipment to NRDS, though it may necessarily be partially disassembled for transportation.

Transducers such as thermocouples and strain gages, that are not particularly susceptible to damage in shipment and do not need recalibration in the field, should be installed in the factory, even though they be NRDS peculiar. Transducers such as platinum resistance-wire temperature probes, accelerometers, and pressure transducers, that are susceptible to damage in shipment or which should be calibrated in the field, should be detached for shipment and subsequent field calibration and reinstallation.

There appears to be a definite requirement for external access through the skin to equipment in the forward bay of NRDS stages, so that work may be performed on equipment there by personnel protected by shielded scaffold platforms. Stages should be designed for remotely controlled or remotely performed mating as well as demating of stage and engine.

To preclude the necessity for a movable weather protective enclosure for the entire stage at the stage test stands, stages should be equipped with necessary fittings to permit enclosed scaffolding at access plates and external apparatus requiring servicing to make a weathertight seal with the stage. It is essential, in view of NRDS weather conditions, that protection against excessive heat, sand, rain, wind, and cold be provided by appropriate design, so that stage preparation work can be performed while the stage is on the test stand.

3.4.2 Descriptive Information

Firm information on the design of captive test stages is not available. Figure 3-12 is generally descriptive of a flight stage designed for 176,000 lb of propellant. Other sized stages, ranging from 100,000 to 205,000 lb propellant capacity, are also under study. Plans call for the first captive test stage to be a battleship-weight stage. Refer to the RIFT Requirements Book and to stage Design Information Packages (DIP's) for more detailed information.

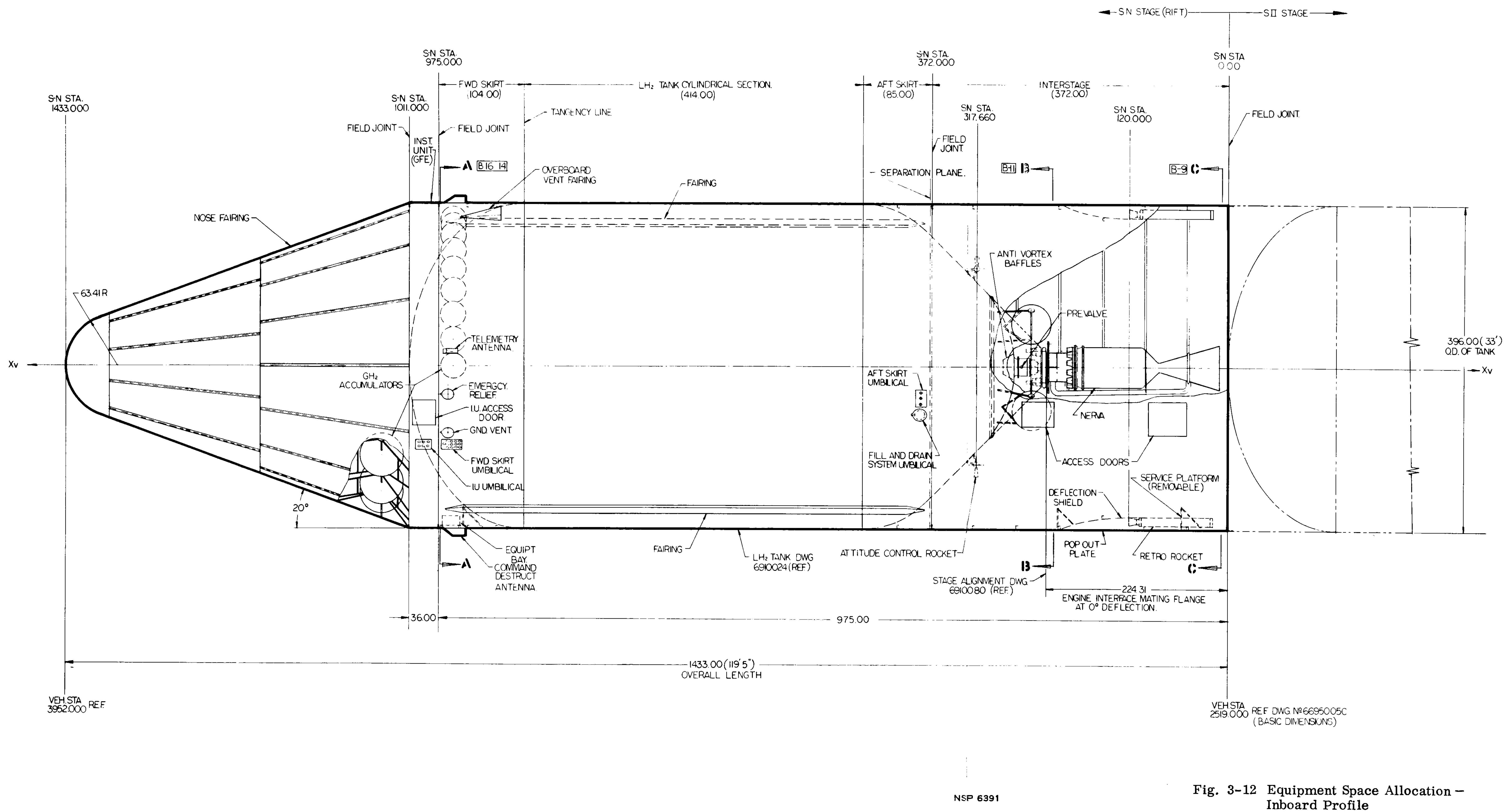

Fig. 3-12 Equipment Space Allocation – Inboard Profile

Section 4
ORGANIZATION

4.1 RESPONSIBILITY OF THE BASE MANAGER, RIFT NRDS OPERATIONS

The Base Manager, RIFT NRDS Operations (RNO) will direct all RIFT Program operations that LMSC carries out at the Nuclear Rocket Development Station (NRDS) pursuant to contract NAS 8-5600 or to the applicable facility contract. He will be responsible to the Director, Test and Assurance (T & PA), of Nuclear Space Programs (NSP), Lockheed Missiles and Space Company (LMSC). His specific functions will be to activate, operate, maintain, and update facility and ground support equipment provided at NRDS for RIFT captive test operations; prepare RIFT stages for test; and conduct tests in such a manner that the mission stated in Section 1 will be accomplished.

4.2 ORGANIZATION OF RIFT NRDS OPERATIONS

Figure 4-1 is an organization chart of RIFT NRDS Operations. Figure 4-2 shows the stages of organizational buildup. Detailed statements of functions and responsibilities pertaining to supervisory positions and a breakdown of personnel by skill classification are contained in Annex F. Brief descriptions of assignments of responsibility and delegations of authority follow.

4.2.1 Assistant Base Manager, RIFT NRDS Operations

The principal function of the Assistant Base Manager will be to manage day-to-day operations according to approved plans, so that progress will be routine. He will have principal, but not exclusive, responsibility for advising the Base Manager, RIFT NRDS Operation, of required revisions to plans, of any impact that RIFT NRDS actions may have on external organizations, and of progress and developments of possible interest to RIFT management. He will exercise line authority over all RNO departments in routine matters, and in the Base Manager's absence from NRDS will act in his place.

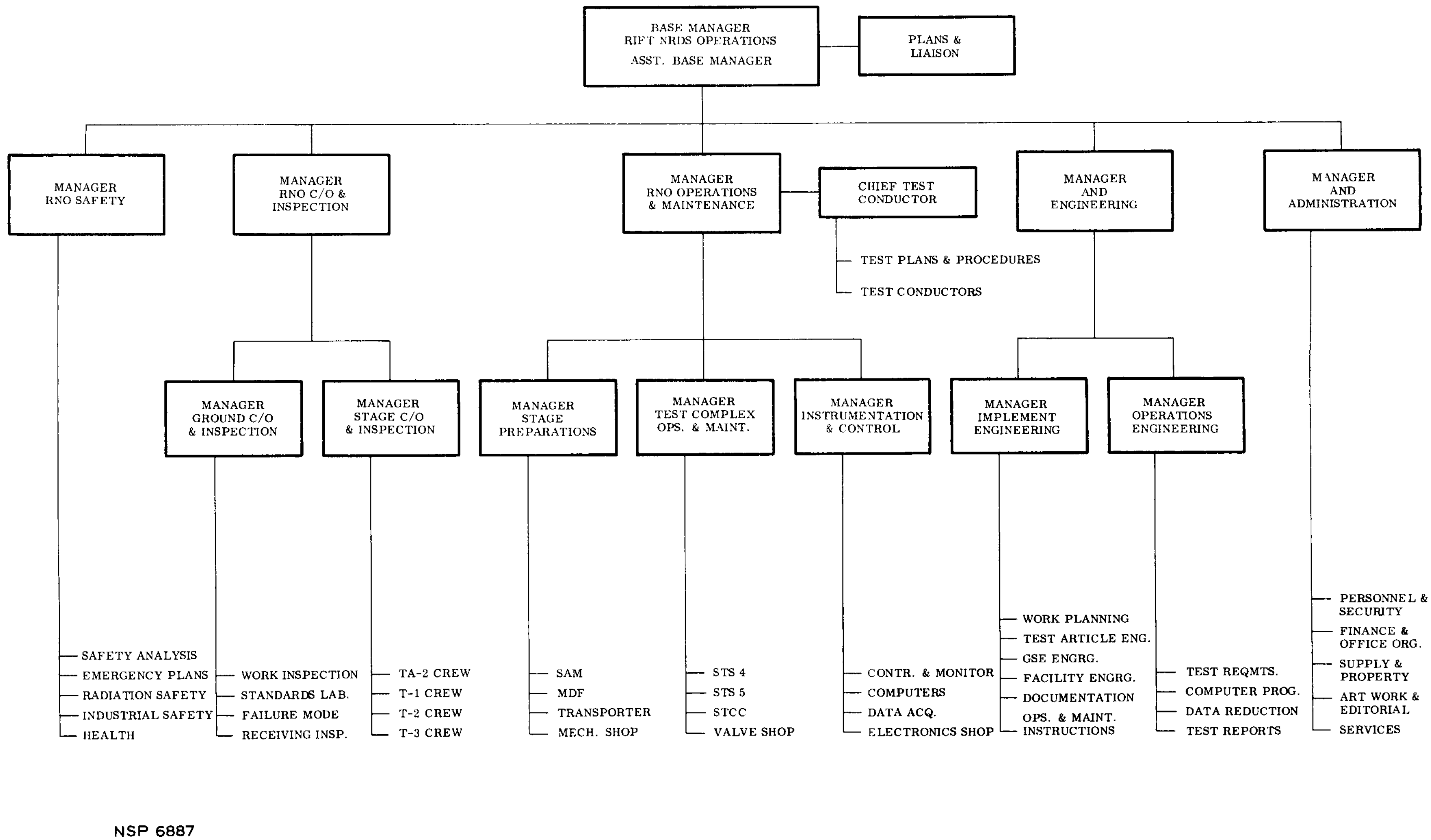

Fig. 4-1 RIFT NRDS Operations (RNO) Organization

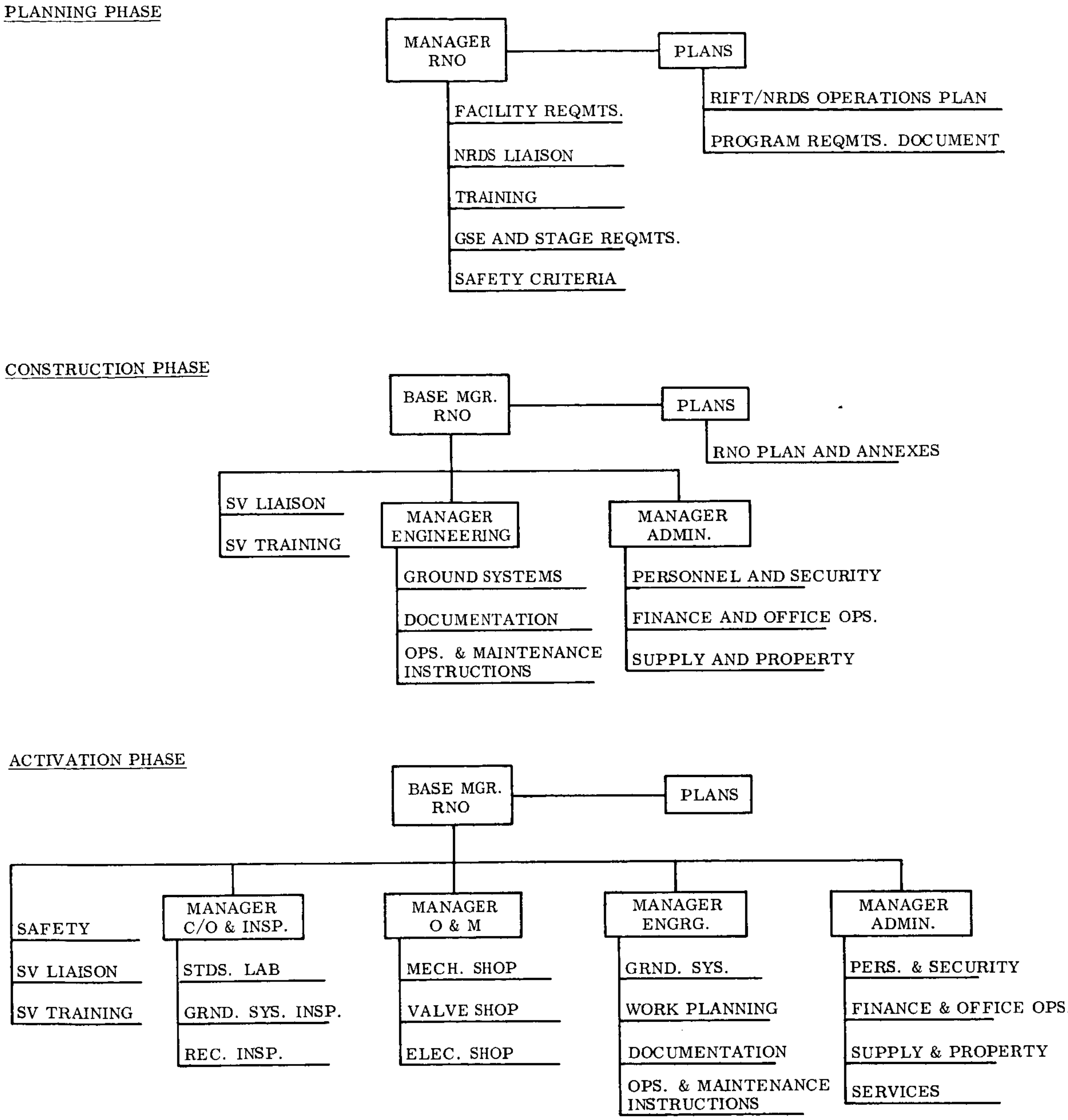

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Fig. 4-2 Organizational Buildup

4.2.2 RNO Operations and Maintenance

The Manager, RNO Operations and Maintenance, is responsible to the Base Manager, RNO, for operations and maintenance carried out on captive test stages. He is responsible for facilities and equipment not otherwise assigned, and test articles. Routine operations and preventive maintenance will be conducted in accordance with operating and maintenance instructions generated by RNO Engineering and approved by the Base Manager. Stage erection, transportation, mating, demating, checkout, and test will be conducted in accordance with procedures drafted by RNO Operations and Maintenance with assistance from RNO Engineering and approved by the RNO Base Manager or higher authority. These operations will be subject to inspection, audit, and verification by RNO Checkout and Inspection. Corrective maintenance, i.e., repairs and modifications on test articles and ground equipment, will be conducted only as authorized by and in accordance with Engineering Orders or Engineering Memoranda as appropriate. Work will be subject to inspection by RNO Checkout and Inspection.

Work of any nature on a RIFT stage will be undertaken only with concurrence of the Stage Crew Supervisor concerned. The Manager, RNO Operations and Maintenance, will be responsible for drafting stage preparation plans, stage test plans, and stage post-test plans for approval by the Base Manager and inclusion in the RIFT NRDS Operations Plan. He will also be responsible jointly with other RNO subdivisions and departments for executing approved plans. He will be responsible for maintaining station logs and for reporting all malfunctions of, and casualties to, test articles and equipment under his cognizance and any hazards or accidents encountered in operations. He will support RNO Engineering in conduct of diagnostic testing of equipment and in maintenance of engineering documentation of equipment; he will support MSFC in operations with the Instrument Unit and will support RNO Checkout and Inspection in the conduct of verification checkout, and inspection of operations and work.

The Manager, RNO Operations and Maintenance, will be responsible for the proper functioning of the Captive Test Organization as outlined below. He will be responsible for the safety of operation by personnel under his control and for compliance with precautions and instructions established by RNO Safety. The Manager, RNO Operations and Maintenance, will have authority to direct the activities of personnel of his subdivision and, in emergency and hazardous situations, will have authority to exercise control over all personnel in RIFT NRDS Facilities.

Chief Test Conductor (CTC). The Chief Test Conductor will be responsible to the Manager, RNO Operations and Maintenance, and to the Base Manager, RNO, for the functioning of the Captive Test Organization in the conduct of cold soak, hydrogen flow tests, and hot firing tests.

The Captive Test Organization will be formally activated prior to flowing hydrogen, and it will continue in being until formal discharge after a test stage and associated ground equipment returns to a dormant condition. When activated, it will consist of the Test Conductors Group, the Stage Crew concerned, the MSFC IU Test Team concerned, the Test Facility Crew concerned, the RNO Instrumentation and Control Department as required, and elements of RNO Safety and Engineering that are assigned.

Authority to proceed with a test run will be obtained through the Base Manager. The CTC will exercise complete operational control over the STCC, the active Test Facility, and the Test Article being tested. He will proceed with testing in accordance with previously approved test plans and procedures. In the event unforeseen situations develop, he will consult the Base Manager for instructions if time permits; when time does not permit consultation, and especially in emergency situations, the Chief Test Conductor is empowered to use his own judgment to protect personnel and equipment and to achieve test objectives, in that order of importance.

Manager, RNO Stage Preparation. The Manager, RNO Stage Preparation, will be responsible to the Manager, RNO Operations and Maintenance, for stage handling, assembly, transportation, mating, and demating. He will be facility manager of the SAM/MDF complex. He will also be responsible for performing maintenance, repairs, and modifications on stage equipment and for supplying mechanical shop support for RNO.

Manager, RNO Test Facility. The Manager, RNO Test Facility, will be responsible to the Manager, RNO Operations and Maintenance, for operating and maintaining mechanical, pneumatic, cryogenic and electric-power ground equipment associated with the test stands and the test control center. He will act as facility manager and exercise operational control of the test stands, fluid storage areas, and STCC when the Captive Test Organization is not active. He will provide general support to RNO in the cryogenic, pneumatic, and hydraulic area.

Manager, RNO Instrumentation and Control. The Manager, RNO Instrumentation and Control, will be responsible to the Manager, RNO Operations and Maintenance, for operating and maintaining ground-based instrumentation, control equipment, checkout equipment, data systems, and other electronic equipment in the SAM/MDF and test facility complexes. He will provide general electronic maintenance and electronic shop support to RNO and will provide data reduction support to RNO Engineering.

4.2.3 RNO Engineering

The Manager, RNO Engineering, will be responsible for initiating action in the field organization necessary to satisfy test objectives, test requirements, and test specifications. He is responsible for diagnosing failures and studying shortcomings of RIFT NRDS ground equipment and for taking design action to make the ground equipment operational and functional as the tool of the operations groups. He is responsible for analyzing stage behavior and diagnosing malfunctions in stage equipment and recommending alterations to NSP Engineering to improve stage design.

The Manager, RNO Engineering, will be responsible for planning work involved in repairs and modifications that are to be made to ground equipment based on RNO Engineering EO's or EM's and to stage equipment based on NSP Engineering EO's and EM's. He will be responsible for documenting facility, ground equipment, and test article configuration. The Manager, RNO Engineering, will also be responsible for assisting in the preparation of handling, mating, demating, checkout, and test procedures and for providing computer programs. He will provide equipment operating and preventive maintenance instructions and support RNO Operations and Maintenance in training personnel. He will also be responsible for data reduction, test data documentation, and test results reporting.

4.2.4 RNO Checkout and Inspection

The Manager, RNO Checkout and Inspection, will have as his main responsibility that of providing independent verification of the readiness of RIFT stages for captive test; the readiness of RIFT NRDS ground equipment to obtain specified test results; the fact that specifications are met in stage preparation operations; and the fact that prescribed procedures are followed in test operations. He will be responsible for the functioning of Stage Crews as described below and for the operation of a laboratory to support verification of calibrations against standards and to support other inspection operations. The Manager, RNO Checkout and Inspection, will also be responsible for providing receiving inspection functions for the RNO organization. He will exercise inspection signoff authority on work done on ground and stage systems by the RNO organization, and have authority to audit test operations to assure that procedures are followed.

Stage Crews. RNO stage crews, each under a supervisor, will follow their respective NRDS stages through factory checkout, full systems acceptance test, and delivery to NRDS. At NRDS, stage crews will exercise control over all work of any nature done on their stages and will monitor and audit all operations performed with their stages. They will exercise inspection authority related to work on their stages and maintain stage logbooks. They will conduct verification checkouts of stages as provided for in RNO plans. During captive test, the stage crew whose stage is being tested will become a part of the Captive Test Organization auditing operations, conducting checkouts, and monitoring stage performance during test.

4.2.5 RNO Safety

The Manager, RNO Safety, will serve as the principal safety advisor to the Base Manager. He will be responsible for carrying out specialized safety functions including providing radiation monitoring where radiation hazards exist, inspecting safety devices, supervising decontamination, auditing operations when plans so provide or unforeseen hazards are encountered, promulgating safety precautions and emergency plans, preparing supplementary safety analysis reports required by SNPO-N and NVPO, operating the Operations Monitoring Station, and carrying out the LMSC health program.

4.2.6 RNO Administration

The Manager, RNO Administration, will be responsible for supporting the RNO organization with needed men, money, and material; for establishing administrative procedures, furnishing office services to increase RNO efficiency, providing a central point for dealings with the NRDS support services contractors, and discharging assigned functions relating to security, travel, visitors, transportation, public information, etc.

4.2.7 RNO Plans and Liaison

The Chief Planner will be responsible for monitoring day-to-day activities of RNO departments, preparing and coordinating schedules, exercising budget control, estimating costs, drafting proposed plans, coordinating these with internal and external agencies, statusing progress, and briefing management and official visitors.

4.3 ORGANIZATIONAL RELATIONSHIPS

4.3.1 Relationship of RIFT NRDS Operations to NSP

The relationships of the RIFT NRDS Operations Organization to various managers and directors in NSP are shown in Fig. 4-3. The solid line shows that the reporting channel of RNO is to the Director, Test and Product Assurance, while the dotted lines indicate other relationships. As a check on the practice in the field of rigorous quality assurance and adequate safety, the Director, Test and Product Assurance, will be represented in the field by one or more Product Assurance and Safety Field Representatives who will exercise such authority as the Director, Test and Product Assurance may direct. In carrying out their functions they will be supported by and maintain liaison

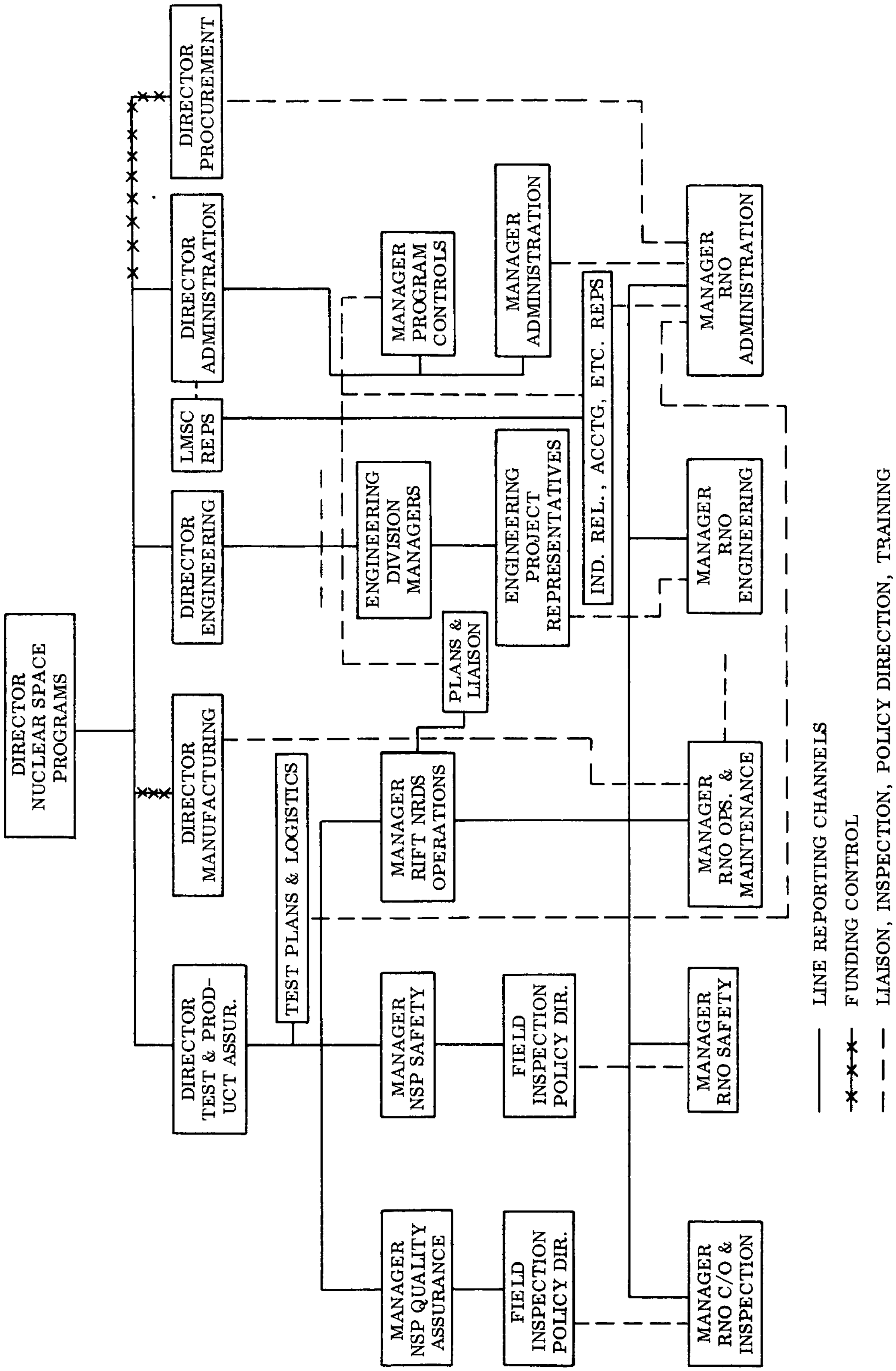

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Fig. 4-3 RIFT Relationships to NSP Managers and Directors with the Manager of RIFT NRDS Checkout and Inspection and the Manager of RIFT NRDS Safety, respectively. A liaison channel between the Director of RIFT Manufacturing and the Manager, RIFT NRDS Operations and Maintenance, will exist for arranging training in stage preparation functions and for arranging temporary assignment of certified skilled workers to NRDS to perform work on the stage which RIFT NRDS Operations personnel are not qualified or certified to perform. A liaison channel for training operations personnel and standardizing procedures will exist between the Manager, RNO Operations and Maintenance, and RIFT organizations operating at the Cold Flow Facility and at the J. F. Kennedy Space Center.

The Director of NSP Engineering will be represented in the field by a number of Project Engineers who will exercise such authority regarding design of experiments, test articles and test equipment and as the Director of Engineering may direct. These Project Representatives will be supported by the Manager, RIFT NRDS Engineering.

A channel for program coordination and statusing will exist between the Manager of NSP Program Controls and the Supervisor of RIFT NRDS Plans and Liaison. LMSC Industrial Relations, Accounting and Contract may have field representatives. These representatives will work with the Supervisor, Plans and Liaison, and be supported by the Manager RIFT NRDS Administration. The latter will also maintain liaison with NSP Test Logistics and NSP Procurement to standardize and coordinate administrative practices and to expedite logistics.

4.3.2 Relationship With Other NRDS Agencies

Other NRDS agencies with which RNO will have business include the following:

NVPO-N	(Customer Representative)
SNPO-N	(Safety, Support, Station Management)
M-Test	(Liaison)
M-Qual	(Liaison)
M-Astr	(IU Operations)
M-FDO	(Facility Design)
SSC	(Support Services Contractor)
CMC	(Facility Construction)
AGC/WEC	(NERVA Interface)
LASL	(Training and Liaison)

With certain of the above, day-to-day working relationships will have to be established. Until these are established and documented, and in any case in programmatic matters, liaison will be through the RNO Plans & Liaison office. Work order requests for support services will be processed and coordinated by RNO Administration (Services).

4.3.3 Assumptions Regarding LMSC Roles at NRDS

a. Primary LMSC responsibility at NRDS, to conduct captive tests so as to satisfy approved test objectives and requirements, of necessity will involve the following:

- Preparing stages and ground equipment for test runs
- Monitoring and controlling the stage by operating ground equipment during test runs
- Exercising operational control of the test area to assure that tests are safely and expeditiously carried out
- Collecting, assembling, and interpreting test results
- Carrying out post-test operations, including refurbishing stage and ground equipment

b. To perform these functions and execute its primary responsibility in NRDS, LMSC will be well staffed there with engineers and technicians trained in RIFT-peculiar test equipment and test procedures. LMSC engineers and technicians collectively will be competent in at least the following specialties:

- Missile structures
- Cryogenic systems including special insulation
- Analog data systems, analog computers, and servo control systems
- Digital data systems and computer techniques, including analog/digital conversion apparatus
- Electric, pneumatic, and hydraulic control systems
- Telecommunication systems
- Remote handling apparatus
- Health physics and radiation safety
- Nuclear engineering and reactor controls
- Instrumentation

- Missile electric power generation, conversion, and regulation
- Data recording and reduction techniques
- Inspection and checkout techniques

c. LMSC will be responsible for maintenance of RIFT test articles and test equipment necessary in the execution of its primary function. For the most part, this maintenance will be performed by the same LMSC personnel required for operations. LMSC will also provide a small group in the skilled trades category – electricians, mechanics, pipefitters, etc. To the extent that routine operations require certain skills to be utilized essentially continuously in operations or maintenance in support of LMSC engineers and technicians the skills will be provided by LMSC employees. On the other hand, work on stage and test equipment requiring skills seldom needed by LMSC in NRDS will be done by NRDS support organization, if they possess the required skills; otherwise it will be done by LMSC personnel brought to NRDS temporarily or by subcontractor or vendor furnished personnel. Additionally, during peaks of maintenance load, LMSC will require skilled trade support from NRDS support organizations.

d. During facility activation, LMSC will assume responsibility for installation and checkout of GSE in RIFT facilities and for items of facility equipment cited as an LMSC responsibility in the RIFT Stage Overall Program Plan. LMSC will build up its staff at NRDS at a rate necessary to perform the installation and checkout functions required, but the level will not exceed that required for subsequent operations. Rather NRDS support services will be used to augment its own force where necessary. In practice, electrical hookup work and interconnecting cabling within a given building will be performed by LMSC or under LMSC supervision, while cables between buildings will be run by construction contractor personnel. Remote control and remote monitoring systems for facility ground systems will likely be installed and connected by LMSC, while mechanical and cryogenic equipment and local control and monitoring systems will be installed by construction contractors.

e. LMSC will assume responsibility for operation and maintenance of the NRDS facilities that are provided primarily for stage captive test operations. Some installations and equipment, though formally categorized as facility rather than GSE, will be so intimately associated physically with GSE or so governed operationally by RIFT peculiar procedures that they will be maintained and operated as stated for

GSE. The on-site stage transporter, the RIFT cryogenic and pneumatic systems, and the STS exhaust duct and instrumentation systems are the principal examples of nominally facility equipment that LMSC will largely operate and maintain. On the other hand, LMSC will rely heavily on NRDS support organization for maintaining buildings and grounds, utility services, standard mobile equipment, and standard communication systems. Section 4.3.4 cites specific support requirements anticipated.

f. LMSC will be staffed in NRDS to control its operations from the safety standpoint, but will rely on support in the specific areas cited in Section 4.3.4.

g. LMSC will be staffed in NRDS in the administrative, logistic, and labor force areas to the extent necessary to give integrity and internal resourcefulness to its organization there. Full-time clerical help, stockroom and RIFT parts warehouse clerks, janitors, and motor vehicle drivers will be provided by LMSC. Personnel in these categories, though not numerous nor uniquely skilled, do contribute much to the efficiency of an organization when subject to close supervision, whereas when they are provided from a loosely controlled pool, they often impede efficiency out of all proportion to their numerical significance. Nevertheless, LMSC will expect to derive support in the administrative area in the instances cited in Section 4.3.4. The examples are such they they can be adequately defined and scoped by work request or analagous forms.

h. In most respects, in the areas of data processing and engineering services, LMSC expects to be self sufficient.

i. The user is frequently in the best position to design and effect facility modifications of the type that experience indicate are needed to achieve test results. Because of the special way in which this effort may have to be funded, authorized, and contracted for, LMSC does not expect to staff to perform work in this area that substantially exceeds the capability of its facility maintenance force together with the field engineering force which it will have, principally for GSE and test article engineering.

4.3.4 ASSUMED RIFT REQUIREMENTS FOR NRDS SUPPORT SERVICES

It is expected that support services will be provided in the following areas:

- On-site housing and recreation; food service at times and places convenient to RIFT operating schedules and facility locations
- Perimeter security, plant protection guards, and guards to enforce access restrictions placed in interests of safety
- Centralized stocking of common materials and common-use hand tools, hardware, and parts (A decentralized stocking point controlled from the central supply will be operated by Lockheed.) Dead-storage space will be provided by the support contractor.
- Site monitoring, except within zones defined to include the areas in which Lockheed personnel conduct or prepare for test operations
- Medical facilities except for first aid stations at RIFT facilities
- Film badge service and supply of pocket dosimeters
- Construction
- Vehicle maintenance and servicing; motor pool
- Heavy machine shop work beyond capacity of RIFT shop facilities
- Carpenter shop work beyond capacity of RIFT shop facilities
- Firefighting services, except for equipment installed in test facilities, but to include provision and maintenance of conventional and portable fire extinguishing equipment
- Water supply
- Electrical power supply to facility connections, including emergency power generating equipment
- Sanitation
- Building maintenance, excluding janitorial service
- Heating, ventilating, and air conditioning equipment maintenance and service
- Photographic film developing and printing; photographic enlarging and reduction (Lockheed will operate a small photo lab for use in connection with test photography checkout and production of original test records.)

- Bus transportation to the site, and on-site shuttle bus service
- Weather forecasting and monitoring
- U. S. Post Office
- Telephone and office intercom service
- X-ray spectrograph
- Secondary standards lab
- Cryogenic test lab facility beyond capacity of RIFT facilities
- Technical library
- Quantity reproduction of drawings, reports, etc.
- Radioactive waste disposal
- Maintenance of fire alarm systems and other site-wide alarm systems
- Propellant and gases logistics
- Photographic services, except for technical test photography
- Administrative equipment maintenance
- Heavy mobile equipment operation
- Chemistry laboratory
- Metallurgical specimen preparation shop
- Materials test laboratory

4.4 RNO TASK STRUCTURE

For purposes of estimating, budgeting, and costing, the identifiable tasks that will be performed in the course of RIFT NRDS operations are structured as indicated in the following tabulations.

TASK DEFINITIONS

14.0.0.0	RIFT NRDS Operations
.1.0.0	Base Management
.1.0	Activity Planning
.1	General – RIFT NRDS Operations Plan
.2	Activation Plan
.3	Validation Plan
.4	Stage Preparation Plans
.5	Test Plans
.6	Post-Test Plan
.7	Reporting Plan
.8	Training Plan
.2.0	Requirements Planning
.1	NRDS Support Requirements
.2	Plant Equipment Requirements
.3	Manpower Requirements
.4	Materials and Subcontract Requirements
.3.0	Implementation Planning
.1	Safety
.2	Quality
.3	Configuration Control
.4.0	Liaison
.1	NRDS Liaison
.2	RSC Liaison
.3	NERVA/RIFT Interface Panel
.4	Static Test Working Group
.5	Checkout Working Group
.6	Nuclear Safety and Hazards Working Group
.5.0	Training
.1	LMSC Education and Training
.2	RIFT NRDS Training

.3 MSFC On-The-Job Training
.4 CFF On-The-Job Training
.6.0 External Support
.1 LASL Industrial Staff Members
.2 NSP Safety Loanees
.3 NSP Quality Loanees
.4 NSP Procurement Loanees
.5 NSP Facility and Support Systems Loanees
.7.0 Internal Coordination
.1 Technical Review Board
.2 Design Release Control Board
.3 Material Review Board
.8.0 Organization
.1 Division Managers
.2 Subdivision Managers
.3 Department Managers
.4 Supervisors
.5 Secretaries
.6 Stenographers
9.0 Program Control
.1 Estimating
.2 Scheduling
.3 PERT
.4 Progress Reporting
.5 Briefings
.6 Budget Control

.2.0.0 Test Operations
.1.0 Test Preparation
.1 Plans
.2 Procedures
.3 Rehearsals

.2.0 Test Runs
.1 Electric Power Tests
.2 Pressure Tests
.3 Cold Soak Tests
.4 Stand Operation Tests
.5 Captive Tests
.3.0 Checkouts
.1 Stage System Checkouts
.2 Stage Integration Checkouts
.3 Ground System Checkouts
.4 Pre- and Post-Test Checkouts

.3.0.0 Stage Preparation and Recovery
.1.0 Stage Handling
.1 Receiving
.2 Erecting
.3 Transporting
.4 Rigging
.5 Tractor Operations
.6 Dummy Stage Operations
.2.0 Assemble, Modify, Repair
.1 Propulsion System
.2 Structures System
.3 Insulation System
.4 Electrical System
.5 Measuring Subsystem
.6 Telemetry, Data Trans., Flight Terminal Subsystem
.7 Flight Control System
.8 Dummy Stages
.9 Environment Control Accessories
.3.0 Measure, Adjust, Align
.1 Transducer Calibrations
.2 Leak Detection
.3 Mechanical Measurements

.4 Alignments
.5 Bench Tests
.6 Continuity Tests
.7 Isolatable Black Box Tests and Adjust
.4.0 Mate-Demate Operations
.1 Engine Receiving
.2 Mating and Demating
.3 Engine Operations Support
.4 Remote Assembly, Modification, Rel.
.5 Radioactive Parts Removal and Storage
.6 Stage Decontamination
.7 Radioactive Materials Counting
.8 Dummy Stage/Engine Operations
.5.0 IU Operations Support
.6.0 Stage Shop Support
.1 Fabricate Tools, Jigs, Fixtures
.2 Repair Mechanical Components
.3 Repair Electrical Components
.4 Make Cable Harnesses
.5 Making Shipping Containers
.6 Assist Stage Modification and Repair
Provide Mech./Elec. Support to GSE

.4.0.0 Base Operation and Maintenance
.1.0 SAM Bay
.1 Install, Adapt, and Proof Test Special Tooling
.2 Install and Adapt Stage Work Stands and Scaffolds
.3 Install, Maintain and Update Stage Service Systems
.4 Equip, Adapt, and Maintain Bench Test Area
.5 Mount and Connect SAM Bay Test Equipment
.6 Checkout and Test Facility Machinery and Equipment
.7 Request, and Monitor SSC Facility Maintenance Modification
.8 Routine Operations

.2.0 Stage Handling

.1 Assemble, Maintain and Update SOST

.2 Install, Maintain and Update SOST Equipment

.3 Assemble, Adapt, and Proof Test Slings, Etc.

.4 Assemble, Maintain, and Update IU Carriage

.5 Checkout and Test SAM Cranes, Carriages, SOST

.6 Routine Operations

.7 Equip, Adapt, Operate Tractors for Remote Handling

.3.0 Mate-Demate Cells

.1 Install, Adapt and Proof Test Special Tooling

.2 Install and Adapt Stage Mountings and Scaffolds

.3 Install, Maintain, and Update Stage Service Systems

.4 Decontaminate Cells

.5 Checkout and Test Facility Machinery and Equipment

.6 Equip, Adapt, and Operate Counting Room

.7 Equip, Adapt, and Operate Cells and Remote Control Room

.8 Request and Monitor SSC Facility Maintenance and Modification

.9 Routine Operations/Cooldown Storage

.4.0 Stage Test Stands

.1 Install and Adapt Stage Mountings Scaffolds and Weather Protection

.2 Install, Maintain, and Update Stage Service Systems

.3 Equip, Adapt, and Operate Stand Local Control Station

.4 Check out and Test Facility Machinery and Equipment

.5 Decontaminate Stands

.6 Request and Monitor SSC Facility Maintenance and Modification

.7 Routine Operations

.5.0 Fluid Storage

.1 Equip, Adapt and Operate Fluid Storage Local Control Station

.2 Check out and Test Facility Machinery and Equipment

.3 Request and Monitor SSC Facility Maintenance and Modification

.4 Equip, Adapt, Operate Valve Shop

.5 Routine Operations

.6.0 Stage Test Control Center

.1 Check out and Test Electric Power System

.2 Check out and Test Monitoring, Alarm and Emergency Communications

.3 Check out and Test Facility Machinery and Equipment

.4 Check out and Test Facility Wiring to LCS and LTS

.5 Install, Hookup, Maintain and Update STS Remove C & M

.6 Install, Hookup, Maintain and Update Fluid Storage Remote C & M

.7 Install, Hookup, Maintain and Update Timing System

.8 Request and Monitor SSC Maintenance and Modification of STCC

.9 Operate Electronics Shop

.7.0 Local Test Stations

.1 Checkout and Test Facility Wiring to Stage Services

.2 Install and Connect Standard Test and C/O Equipment

.3 Install, Hookup, Maintain and Update Electrical LCS

.4 Install, Hookup, Maintain and Update Stage and IU Local C & M

.5 Install, Hookup, Maintain and Update Stage and IU Local DDA

.6 Install, Hookup, Maintain and Update Interface Substitutes

.7 Install, Hookup, Maintain and Update Stage Service C & M

.8 Install, Hookup, Maintain and Update Technical Communications

.9 Operate With Dummy Stages, Umbilical Test Sets, Simulators

.8.0 Remote Test Station C & M

.1 Install, Hookup, Maintain and Update Stage, IU, and LS C & M

.2 Install, Hookup, Maintain and Update SN, IU, Eng, and LS Simulators

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NOTE: C & M = Control & Monitor
C/O = Checkout
DDA = Digital Data Acquisition
LTS = Local Test Station
LCS = Local Control Sta.
RCS = Remote Control Sta.
SSC = NRDS Support Services Contractor
LS = Lower Stage

.3 Install, Hookup, Maintain, and Update Analog Data Recorders

.4 Install, Hookup, Maintain, and Update Interlock and Sequence Coord.

.5 Install, Hookup, Maintain, and Update Ground Instrumentation

.6 Install, Hookup, Maintain, and Update Optics

.7 Install, Hookup, Maintain, and Update Technical Communications

.8 Operate with Dummy Stages and Simulators

.9.0 DDA and Automatic C/O

.1 Install, Hookup, Maintain and Update Stage DDAS and Access Equipment

.2 Install, Hookup, Maintain and Update Telemetry Ground Stations

.3 Install, Hookup, Maintain and Update Digital Data Display and Recorders

.4 Install, Hookup, Maintain and Update Computer and Computer Control

.5 Install, Hookup, Maintain and Update SN, IU, LS, GSE and STA RCS

.6 Install, Hookup, Maintain and Update Data Translators and Buffers

.7 Support IU C/O and DDA

.8 Debug and Check out Computer Programs

.9 Operate with Simulators and Dummy Stages

.5.0.0 Base Engineering

.1.0 Test Article Engineering

.1 PWDT, ETD, DPM, ONP, ORW & SS – Propulsion System

.2 PWDT, ETD, DPM, ONP, ORW & SS – Structures System

.3 PWDT, ETD, DPM, ONP, ORW & SS – Insulation System

.4 PWDT, ETD, DPM, ONP, ORW & SS – Electrical System

.5 PWDT, ETD, DPM, ONP, ORW & SS – Measuring Subsystem

.6 PWDT, ETD, DPM, ONP, ORW & SS – Telemetry Data, Flight Termination

.7 PWDT, ETD, DPM, ONP, ORW & SS – Flight Control System

.2.0	Engineering Support	
.1		OOR, MAD, ONP, ONW & SS – Dummy Test Articles
.2		OOR, MAD, ONP, ONW & SS – Simulator Equipment
.3		OOR, MAD, ONP, ONW & SS – Remote Manipulator Tools
.4		OOR, MAD, ONP, ONW & SS – Handling Equipment
.5		OOR, MAD, ONP, ONW & SS – Stage Repair Tooling
.6		OOR, MAD, ONP, ONW & SS – Scaffolding
.7		OOR, MAD, ONP, ONW & SS – Racks, Bins, Fixtures
.8		OOR, MAD, ONP, ONW & SS – Test Apparatus
.3.0	GSE Engineering	
.1		OPD, DNM, ORW, SS & IIM C & M System
.2		OPD, DNM, ORW, SS & IIM DDA System
.3		OPD, DNM, ORW, SS & IIM C/O System
.4		OPD, DNM, ORW, SS & IIM SOST
.5		OPD, DNM, ORW, SS & IIM Ground Instrumentation
.6		OPD, DNM, ORW, SS & IIM Technical Communications
.7		OPD, DNM, ORW, SS & IIM Stage Service Systems
.4.0	Facility Engineering	
.1		SFR, DMM, PSU, RFD, MC & IIM SAM Bay
.2		SFR, DMM, PSU, RFD, MC & IIM Mate Demate
.3		SFR, DMM, PSU, RFD, MC & IIM STS & LCS
.4		SFR, DMM, PSU, RFD, MC & IIM Fluid Storage & LCS

NOTE: PWDT, ETD, DPM, ONP, ORW & SS = Plan & Witness Diagnostic Tests, Evaluate Test Data, Design Proposed Modifications, Order Necessary Procurement, Order Remedial Work, Specify Standards

OOR, MAD, ONP, ONW & SS = Observe Operational Requirements, Make Appropriate Designs, Order Necessary Procurement, Order Necessary Work, & Specify Standards

OPD, DNM, ONP, ORW, SS & IIM = Observe Performance Deficiencies, Design Necessary Modifications, Order Necessary Procurement, Order Remedial Work, Specify Standards & Issue Instruction Manuals

SFR, DMM, PSU, RFD, MC & IIM = State Facility Requirements, Design Minor Modifications, Plan Space Utilization, Review Facility Design, Monitor Construction, & Issue Instruction Manuals

.5 SFR, DMM, PSU, RFD, MC & IIM STCC & LTS

.6 SFR, DMM, PSU, RFD, MC & IIM Monitoring, Alarm & Emerg. Comm.

.7 SFR, DMM, PSU, RFD, MC & IIM Admin. & Engrg. Spaces

.8 SFR, DMM, PSU, RFD, MC & IIM Shops, Labs, Warehouses

.9 SFR, DMM, PSU, RFD, MC & IIM Site Development & Utilities

.5.0 Configuration Control

.1 Operate Satellite Design Release Center

.2 Communicate as Built Configuration to RIFT Release Center

.3 Provide Drafting Services

.6.0 Operations Engineering

.1 Review Test Requirements and Specifications

.2 Approve Operational Procedures

.3 Develop and Code Computer Programs

.4 Reduce Test Data

.5 Evaluate Test Operational and Test Equipment Performance

.6 Write Test Reports

.7 Instruct Operations Personnel

.8 Operate Photo Lab

.6.0.0 Base Checkout & Inspection

.1.0 Stage Crews

.1 C & IW, C/O, VR, MC & PDT, Propulsion System

.2 C & IW, C/O, VR, MC & PDT, Structures System

.3 C & IW, C/O, VR, MC & PDT, Insulation System

.4 C & IW, C/O, VR, MC & PDT, Electrical System

.5 C & IW, C/O, VR, MC & PDT, Measuring Subsystem

.6 C & IW, C/O, VR, MC & PDT, Telemetry, Data Trans, Flt. Term.

.7 C & IW, C/O, VR, MC & PDT, Flight Control System

.8 C & IW, C/O, VR, MC & PDT, Engine System

.9 Maintain Stage Log

NOTE: C & IW = Control & Inspect Work
C/O = Checkout
VR = Verify Readiness
MC & PDT = Monitor Condition and Performance During Test

.2.0 GSE Inspection
.1 C & IW, C/O, VR, M & AO, Stage Service System
.2 C & IW, C/O, VR, M & AO, Local Test Stations
.3 C & IW, C/O, VR, M & AO, Control and Monitoring System
.4 C & IW, C/O, VR, M & AO, Digital Data Acq. System
.5 Automatic Checkout System
.6 Stage On Site Transporter
.7 Ground Instrumentation
.8 Optics
.3.0 Facility Inspection
.1 C & IW, VR, SAM Bay
.2 C & IW, VR, Mate Demate
.3 C & IW, VR, STS
.4 C & IW, VR, Fluid Storage
.5 C & IW, VR, STCC
.4.0 Receiving Inspection
.1 Provide Receiving Inspection
.2 Operate Bonded Stores
.5.0 Standards Lab
.1 Equip, Operate Standards Lab
.2 Verify Instrument Calibration
.6.0 Reliability
Failure Mode Analysis

.7.0.0 Base Safety
.1.0 Safety Plans and Staff Support
.1 Prepare Emergency Plans
.2 Analyze and Estimate Hazards From Postulated Incidents
.3 Prepare Supplemental Safety Analysis Reports
.4 Prepare Safety Precautions and Procedures
.5 Review Facility Designs for Safety Provisions
.6 Review Operation Plans and Procedures for Safety

NOTE: M & AO = Monitor and Audit Operations

.2.0 Operational Radiation Safety
.1 Monitor Radiation and Control Exposure
.2 Operate Operations Monitoring Sta.
.3 Certify Crews for Radiation Hazard Operations
.4 Maintain Prediction of Effluent Movement
.5 Maintain Status of Radioactivity in RIFT Site
.6 Establish Area Access Controls
.7 Operate STCC and SAM Change Rooms
.8 Supervise Decontamination Ops
.9 Inspect and Test Rad. Safety Devices and Alarms
.3.0 Trial Safety
.1 Monitor and Augit Hydrogen and Other Hazardous Ops
.2 Issue Protective Clothing and Equipment
.3 Inspect and Test Safety Devices, Fire and H_2 Alarms
.4 Certify Crews For Industrial Hazard Operations
.5 Post Safety Precautions – Instruct Instruct Personnel
.6 Conduct Emergency Drills
.7 Equip and Operate First Aid Stations
.8 Implement LMSC Safety Program
.4.0 Records and Reports
.1 Maintain and Review Personnel Health Records
.2 Prescribe Physical Examinations
.3 Document Abnormal Exposures and Injuries
.4 Record and Report Radioactive Materials
.5 Fissionable Materials Records and Reports

.8.0.0 Base Administration
.1.0 Personnel and Security
.1 Recruiting Support
.2 Operate Las Vegas Office
.3 Visitor Arrangements
.4 Personnel Services
.5 Prepare Security Instructions and Inspect
Personnel Records
Industrial Relations

.2.0 Office Operations
- .1 Central Mail Room and Mail Distribution
- .2 Document and Correspondence Control
- .3 Technical Publications Library and Distro.
- .4 Central Files
- .5 Reproduction
- .6 Message Center
- .7 Clerical Pool

.3.0 Finance and Budget Control
- .1 Time Charges
- .2 Cash Operations
- .3 Budgeting and Statusing
- .4 Estimating

.4.0 Supply and Property
- .1 Procurement
- .2 Receiving and Distributing
- .3 Operate Spare Parts Warehouse
- .4 Operate Min-Max Stockroom
- .5 Operate Tool Crib
- .6 Subcontracts
- .7 Property Management

.5.0 Services
- .1 Coordinate Requests for Support Services
- .2 Operate Labor Pool
- .3 Provide RIFT Site Transport
- .4 Janitorial Services

Section 5
CONCEPT AND SEQUENCE OF OPERATIONS

5.1 PHASES

The time relationships of milestone events in the RIFT program and RIFT NRDS operations is presented in Fig. 5-1. Rift NRDS operations will involve five different phases of activity -- planning, activation, validation, operation, and termination. The time periods of these different phases are indicated in Fig. 5-2, along with the schedule time spans for construction, activation, and validation. The schedule for stage test operations is presented in Figs. 5-5 and 5-6 for both optimistic and pessimistic assumptions.

5.1.1 Planning Phase

The following tasks will be accomplished during the planning phase:

- Test objectives, required test results, operational concepts and criteria, and target dates will be established. NSP Engineering has principal responsibility for developing test objectives and test requirements. NSP Test and Product Assurance has principal responsibility for determining operational concepts and criteria and the feasibility of achieving test objectives and satisfying test requirements with available resources. Target dates for accomplishing milestone events are established by RIFT Program direction, based on consideration of objectives, capabilities, and cost.
- Captive test facility criteria will be derived and test facility requirements will be established. NSP Test and Product Assurance will determine operational requirements for test facilities and document them in this plan. NSP Engineering will state combined engineering

and operational requirements for RIFT NRDS facilities to Marshall Space Flight Center. Captive test facilities will be designed and constructed as noted in Section 3 of this plan.

- Equipment for RIFT NRDS facility activation will be manufactured or procured and delivered to NRDS during the activation phase as needed.
- NSP Test and Product Assurance will train RIFT NRDS personnel in LMSC plants and offices, at selected vendors establishments, and at the site of the engine contractor's operations. Selected test operations personnel will serve as Industrial Staff Members on loan to Los Alamos Scientific Laboratory KIWI program to receive on-the-job training and to introduce KIWI test experience into planning RIFT captive test facilities, equipment, and operations.
- A RIFT NRDS Operations organization will be established within the Test and Product Assurance Directorate, with headquarters in Sunnyvale and a branch in NRDS.
- Planning for RIFT NRDS Operations will be accomplished by NSP Stage Test and, after it has been formed, by RIFT NRDS Operations. The planning will be of a scope and character required to furnish and to keep current the information intended to be in the body of this plan and in Annexes A, F, G, H, I, and L.

5.1.2 Activation Phase

During the activation phase, the following will be accomplished:

- The RIFT NRDS Operations organization will establish its headquarters in NRDS and acquire administrative, logistic, technical, and operational capability there.
- Manpower buildup and personnel indoctrination in operational, maintenance, safety, and administrative procedures will be carried out.

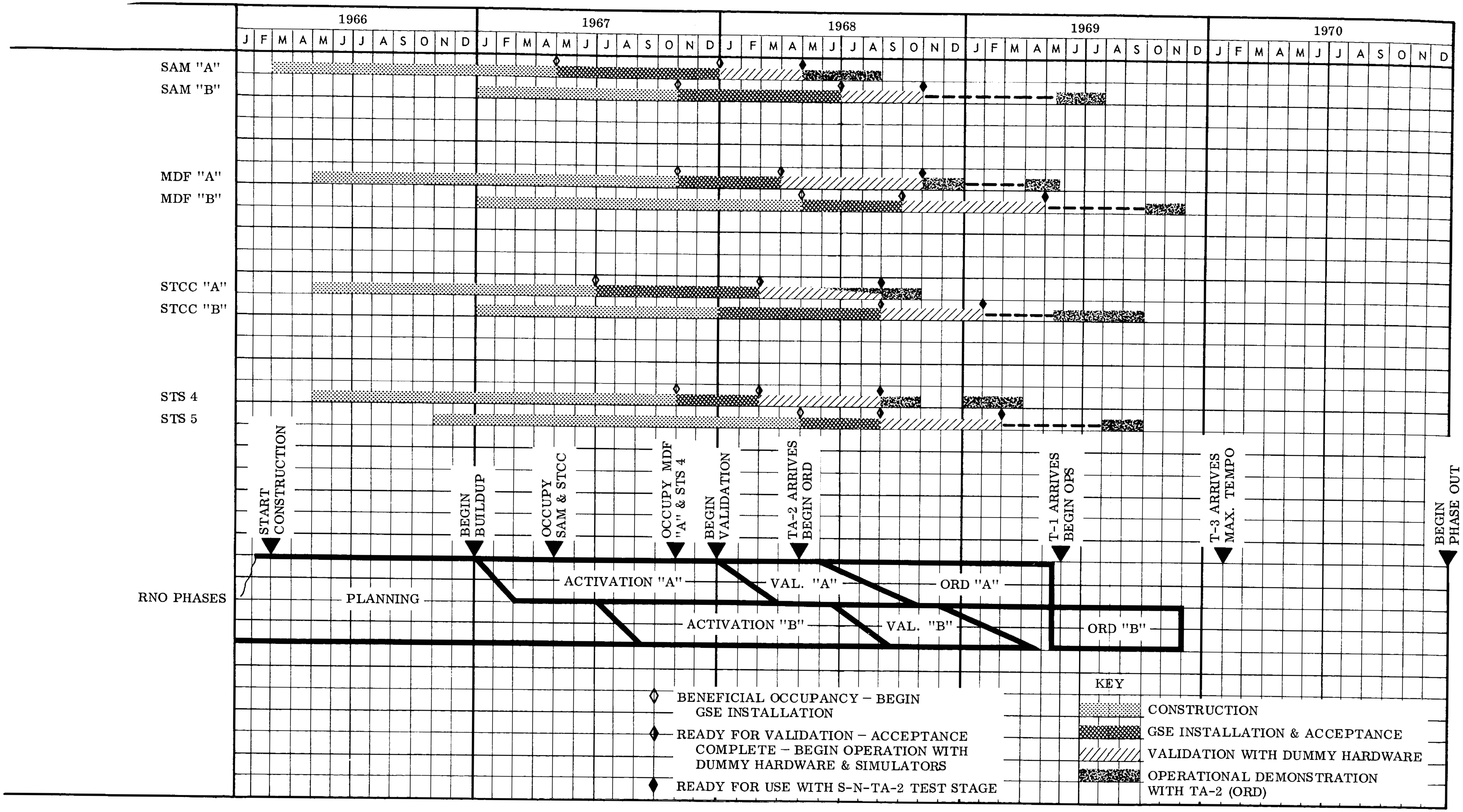

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Fig. 5-2 RIFT NRDS Operations Time Phasing

- The RIFT NRDS Operations organization will assume responsibility for maintenance of facilities occupied as RIFT user facilities. Maintenance will be accomplished by RIFT NRDS Operations personnel or by SNPO-N furnished support services personnel acting under RIFT NRDS Operations supervision, depending upon the nature of the work, according to the ground rules cited in Section 4.3.3.
- NSP Engineering will issue engineering orders, installation drawings, bills of material, and specifications needed for installing LMSC acquired equipment at NRDS.
- Stocks of materials, small tools, and spare parts will be established in RIFT facilities, and a minimum-maximum stock control system will be instituted by RIFT NRDS Operations. Procurement, logistics, and property policies and procedures of LMSC and NASA as appropriate will be complied with.
- Portions of government-furnished plant equipment called out in Annex A and generally all LMSC acquired equipment (i.e., GSE) will be received, warehoused, inspected, and installed in RIFT facilities which have been turned over to RIFT NRDS Operations. The installation will be accomplished by one of the following arrangements as detailed in Annex A:

  (1) By RIFT NRDS Operations personnel.
  (2) By vendors under RIFT NRDS Operations operational control and logistic support.
  (3) By NRDS Support services personnel under supervision of RIFT NRDS Operations.

  The installation will be as specified in NSP engineering orders for LMSC acquired equipment and as specified in RIFT NRDS engineering orders for facility equipment. RIFT Engineering, during this phase, will be responsible for design work necessary to make the installed GSE operate as intended. RIFT NRDS Operations will be responsible for taking necessary action to make RIFT user facilities operate as intended. RIFT NRDS Operations will carry out minor modifications subject to compliance with documentation requirements. Support service organizations assistance will be used where the scope or nature of the work lies beyond the capacity of RIFT NRDS Operations, as defined in Section 4. Major modifications to facilities will follow the same procedures used in determining requirements for, designing, and constructing original facilities.

- RIFT NRDS Operations will generate, submit for approval, and execute activation acceptance procedures. As installed GSE is accepted, RIFT NRDS Operation will assume responsibility for maintenance and operation.
- Annexes J, K, and M, implementing RIFT Safety and Product Assurance plans, and various reporting requirements will be developed, formalized, and put into practice. Annex B, detailing operations, procedures, and operating instructions to be followed during the validation phase, will be prepared and submitted for approval.
- NSP Engineering will supply RIFT NRDS Operations with engineering drawings, specifications, and operating manuals covering as-installed GSE at the time of GSE acceptance testing.

5.1.3 Validation Phase

The following will be accomplished during the validation phase:

- RIFT NRDS facilities that have been activated will be operated, using master gages, dummy test articles, and simulators as detailed in Annex B, in order to demonstrate functional and operational suitability of the facility and installed equipment, the qualifications of personnel, and operational procedures.
- Once activation acceptance procedures have been carried out and the installed GSE has been accepted by RIFT NRDS Operations, RIFT NRDS Operations will be responsible for designing, effecting, and documenting

minor changes to ground equipment. A satellite design release center will be operated to exercise local configuration control. Such field-initiated changes will be reviewed by NSP Engineering and formally processed as design changes in the central RIFT release system. Major modifications to GSE will be designed by NSP Engineering and effected as described in Section 5.1.2 for the original installation.

- Computer programs for automatic GSE will be adapted from those in use at the CFF or will be developed as needed by RIFT NRDS Operations. These will be subject to review in the same manner as test procedures.
- Annexes C, D, and E, covering detailed plans for stage preparation, captive test, and post-test operations, will be finalized and submitted for approval.

5.1.4 Operational Phase

During the operational phase, the tests needed to achieve the objectives cited in Section 1 will be conducted on RIFT stages of various configurations.

- The activity that takes place as a given stage-engine combination is made ready for firing, is test fired, and is dismantled after testing, is referred to as a stage-test cycle. A stage-test cycle comprises three sequences:

  (1) Stage preparation sequence
  (2) Stage test sequence
  (3) Stage post-test sequence

  For each uninterrupted residence of a stage on a test stand, during which a series of firings may be held, a detailed plan listing the steps involved in conducting the stage cycle is presented as a part of this plan in Annex C.
- The stage cycles described in Section 5.2 are planned. RIFT NRDS Operations will be responsible for planning and executing stage cycles so that pertinent test directives are carried out and test reporting

requirements are satisified. RIFT NRDS Operations will also be responsible for complying with SNPO-N safety requirements and for obtaining SNPO-N permission to conduct each hot firing test.

- NSP Safety will prepare a safety analysis report (SAR) for each significantly different stage-stand combination involved in the captive test operation. RIFT NRDS Operations will furnish operational information as inputs to the SAR. RIFT NRDS Operations will prepare required supplemental safety analysis reports for each series of firings in a test cycle.
- Operational readiness demonstration (ORD) tests will be run on the validated facility, using S-N-TA-2 prior to using the facility for hot firing. Detailed plans for ORD tests are included in Annex C.

5.1.5 Termination Phase

An orderly plan of rollup will be developed at an appropriate time.

5.2 SEQUENCE OF OPERATIONS

5.2.1 Base Line Stage Cycles

Times allotted to the steps of a stage cycle under various assumptions, to establish a base line for scheduling stage cycles, are tabulated here.

(1) Stage Preparation Sequence – First Cycle For a Given Stage

SAM

Receive	2 days
Erect	1
Inspect	3
Checkout blackboxes and components	5
Assemble cold soak configuration	5
Test stage systems	5

Leak Test		4	
Install IU		2*	
Integrated test article checkout		3*	
TRANSPORTER			
Transport to STS		1	
	Without IU	25 days	5 weeks
	With IU	30 days*	6 weeks*
STS			
Emplace		1	
Hook up		1	
Calibrate and align		3	
System checkout and dummy runs		4	
Leak test		2	
Cold soak		3	
TRANSPORTER			
Transport to MDF		1	
		15 days	3 weeks
MDF			
Assemble captive test configuration		5	
Stage subassembly full checkout		5 -----------	engine
Receive engine		1	
Engine system checkout		4	
Mate and practice demate		5	
Integrated stage checkout		4	
TRANSPORTER			
Transport to STS		1	
		25 days	5 weeks
Total Sequence Time	With IU		14 weeks*
	Without IU		13 weeks

(2) Stage Preparation Sequence – Recycled Stage Including Rework Before Testing

SAM	
Repair and modify	30
Checkout blackboxes and components	5
Assemble cold soak configuration	4
Test stage systems	5

Leak test	5	
Install IU	2*	
Integrated test article checkout	3*	
TRANSPORTER		
Transport to STS	1	
Without IU	50 days	10 weeks or
With IU	55 days	11 weeks*
STS		
Emplace	1	
Hook up	1	
Calibrate and align	3	
System checkout and dummy runs	4	
Leak test	2	
Cold soak	3	
TRANSPORTER		
Transport to MDF	1	
	15 days	3 weeks
MDF		
Assemble captive test configuration	5	
Stage subassembly full checkout	5 ----------	engine
Receive engine	1	need date
Engine system checkout	4	
Mate and practice demate	5	
Integrated stage checkout and leak test	4	
TRANSPORTER		
Transport to STS	1	
	25 days	5 weeks
Total Sequence Time With IU		19 weeks
Without IU		18 weeks

(3) Stage Preparation Sequence – Recycled Stage, No Rework

MDF		
Restore captive test configuration	5	
Stage subassembly full checkout	5 ----------	engine
Receive engine	1	need date
Engine system checkout	4	

Mate and practice demate	5		
Integrated stage checkout and leak test	4		
TRANSPORTER			
Transport to STS	1		
	25 days		5 weeks

(4) Stage Test Sequence – No Work On Stage In Stand Between Runs

STS			
Emplace	1		
Hook up	2		
Calibrate and align	10		
Integrated system checkout and leak checks	10		
Dummy runs	5	----------	First
First firing of series	1		fire
Post firing checkout	2		
Second firing of series	1		
Post firing checkout	2		
Third firing of series	1		
Post firing checkout and cooldown	4		
TRANSPORTER			
Transport to MDF	1		
	40 days		8 weeks

(5) Stage Test Sequence – Work Between Runs Assumed

STS			
Emplace	1		
Hook up	2		
Calibrate and align	10		
Integrated system checkout and leak tests	10		
Dummy runs	5	----------	First
First firing of series	1		fire
Post firing checkout	2		
Rework stage systems	5		
Integrated systems checkout	5		
Second firing of series	1		
Post firing checkout	2		
Rework stage systems	5		
Integrated systems checkout	5		
Third firing of series	1		
Post firing checkout and cooldown	4		
TRANSPORTER			
Transport to MDF	1		
	60 days		12 weeks

(6) Post-Test Sequence – Stage to be Reworked on Next Cycle

MDF		
Emplace	1	
Demate	5	
Decontaminate	6	
Remove hot stage components	7	
TRANSPORTER		
Transport to SAM	1	
	20 days	
SAM		
Post-test examination and IU Removal	20	
	40 days	8 weeks

(7) Post-Test Sequence – Stage Not to be Reworked on Next Cycle

MDF		
Emplace	1	
Demate	5	
Decontaminate	4	
Post-test examination	10	
	20 days	4 weeks

Base Line Stage Cycles – Elapsed Times. The times to complete stage cycles of various compositions are illustrated in Fig. 5-3. Cycles are distinguished by a three-character designation. The first character designates the stage preparation sequence. "X" indicates initial stage cycle; "I", rework; "II", no rework. The second character designates the test sequence. "A" indicates no work on the stage while it remains on the stand between firings; "B" stands for a test sequence that includes some work on the stage between firings. The third character designates the post-test sequence used. "I" is for a post-test sequence that anticipates rework of the stage during the next cycle; "II", for a post-test sequence when no rework is to be undertaken on the stage during the succeeding cycle. The figure shows that the assumptions used lead to stage cycles of about twenty weeks duration when the stage is not cycled through SAM, and of thirty to forty weeks duration when the stage is brought to SAM for rework.

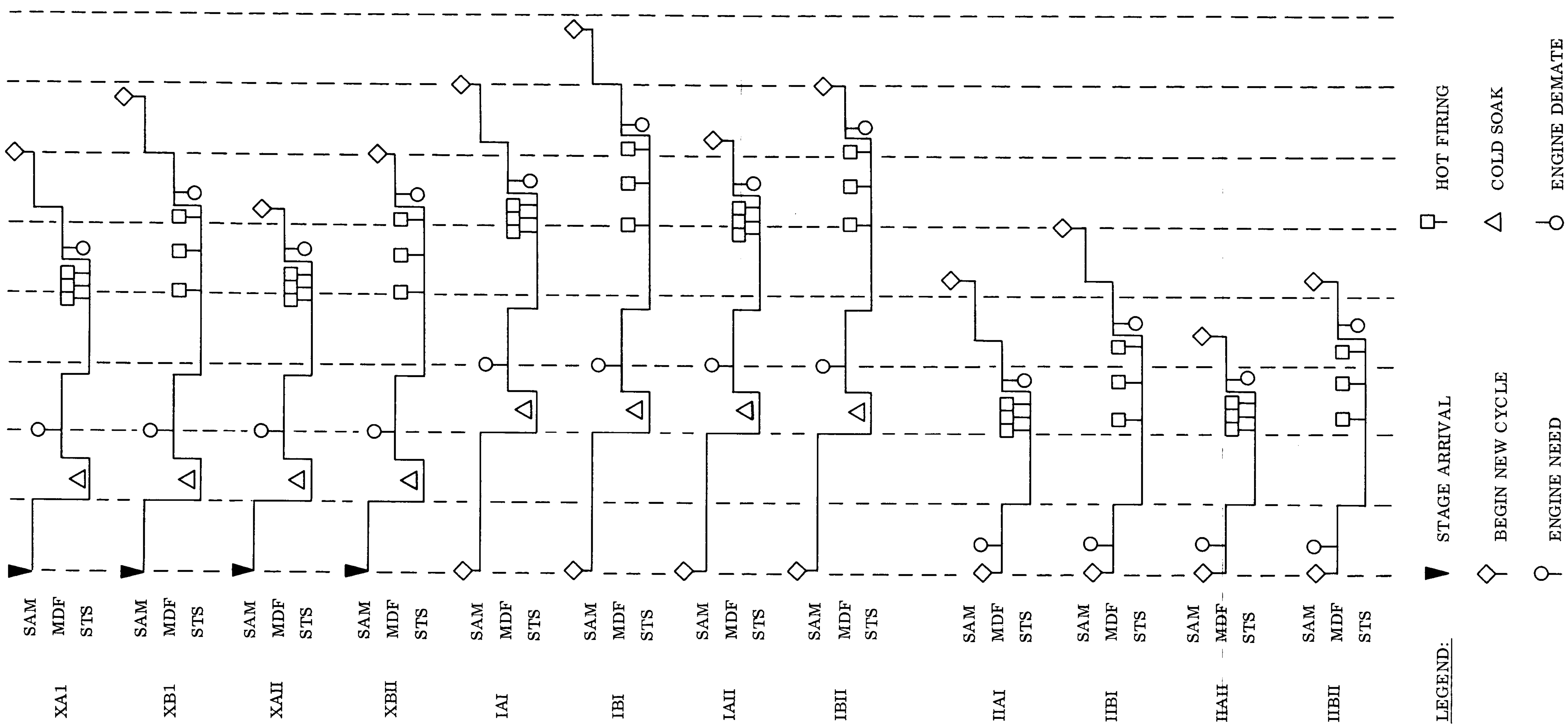

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Fig. 5-3 Base Line Stage Cycles

5.2.2 Facility Constraints

Three kinds of constraints may act to impose additional time lapses in the cycling of stages successively through the test facility. The three types are (1) facility maintenance that must be performed without a stage residing in the structure in question or which, if performed with a stage present, interferes with the performance of scheduled maintenance and operations on the stage; (2) facility cooldown that must be given time to occur before emplacing a succeeding stage, or facility decontamination that must be accomplished before bringing a stage that is radiologicaly cold into the structure in question; and (3) ground equipment modification that must be effected as a result of modifications performed on a test stage or as a result of new test requirements. The last includes automatic equipment reprogramming that must be done for similar reasons.

Estimates of Durations of Facility Constraints. Probable length of various constraints are as follows:

Test stand cooldown after removal of test stage	5 days
Test stand preparation for a new stage	10 days
Test equipment modification for modified stage	30 days
Tool make for new remote handling operation	10 days
Transporter down time	30 percent
Fluid resupply	5 days
Demate cell decontamination	2 days
Demate remote handling down time	20 percent
Stand exhaust duct repair/replacement	20 days

5.2.3 Learning Curve Factors

Assumptions: Let first stage cycle efficiency be 50%

Let inefficiency reduce by 25% each time a cycle is completed

Let learning be cumulative for stage cycles irrespective of the stage being cycled

Resulting efficiencies:

Cycle No.	1	2	3	4	5	6	7	8	9
Efficiency	0.5	0.62	0.72	0.79	0.84	0.88	0.91	0.93	0.95
Time factor	2.00	1.60	1.39	1.27	-.19	1.14	1.10	1.08	1.05

5.2.4 Operational Assumptions

a. Three different test stage configurations will be employed at NRDS
   (1) S-N-TA-2, initially at least, will be a stripped down stage with provisions for piggyback experiments. It will be equipped with components unique to this stage.
   (2) S-N-T-1 and S-N-T-2 will be almost like the flight stages in design, but will differ enough from the design which is to be stage qualification tested when they are delivered to NRDS to require modification after their first cycle. S-N-T-1 will require extensive field modification; S-N-T-2 will require only minor modification.
   (3) S-N-T-3 will have the configuration when it is delivered that is to be qualification tested. After modification, the S-N-T-1 and -2 stages will also have this configuration.

b. Notwithstanding (1) above, S-N-TA-2 will be delivered to NRDS in a ready-to-fire configuration, except for reassembly of certain components that may have been removed for ease of shipment.

c. S-N-T-2 and S-N-T-3 will be fired with actual Instrument Units mated to them; the other two stages will be fired with IU simulators.

d. Engines for S-N-TA-2 and, if necessary, the first cycle of S-N-T-1 may be R&D GVX type engines; the remainder will be PFRT engines.

e. All engines will have capability for three or more restarts.

f. During the first cycle of a given stage, no time will be planned for repair or modification of the stage between firings while it remains on the stand; on succeeding cycles, time for a modest amount of work between firings while the stage remains on the stand will be allowed for.

5.2.5 Intermeshing Stage Cycles

For possible use in future planning, ways in which base line cycles of various compositions can be intermeshed are presented in Fig. 5-4.

5.2.6 Uncertainty Bracketing Factors

The estimates of times required for performing various functions stipulated in this section are subject to large uncertainties caused by lack of detailed information concerning the design of test articles, facilities, and equipment. Because such uncertainties exist, the following assumptions are necessary:

- Hypothesized schedules may be bettered in actual practice when deducing requirements for equipment delivery and operational support.
- They may not be possible to meet when committing the operation at this time to producing results upon which other facets of the RIFT program depend in important ways. Factors are applied, therefore, to yield an optimistic schedule for requirements, planning purposes and to yield a pessimistic schedule for capabilities estimating.

The factors chosen are ± 20 percent.

5.2.7 Operational Readiness Demonstration (ORD) Cycles

A primary purpose of operations conducted with the S-N-TA-2 stage is to demonstrate that the test facility is ready for stage qualification testing. Accordingly, the initial cycle of that stage through the facility will be used to test the facility and to reveal instances where deficiencies need correction. However, since an extensive program, detailed in Annex B, of facility validation using dummy engines and stages, stage simulators, and other devices will already have been completed, it is not expected that ORD cycles must be planned as separate from the initial cycles of S-N-TA-2 through the facility, including captive test. Rather, during the first part of the time that S-N-TA-2 resides in a particular part of the facility for the first time in its

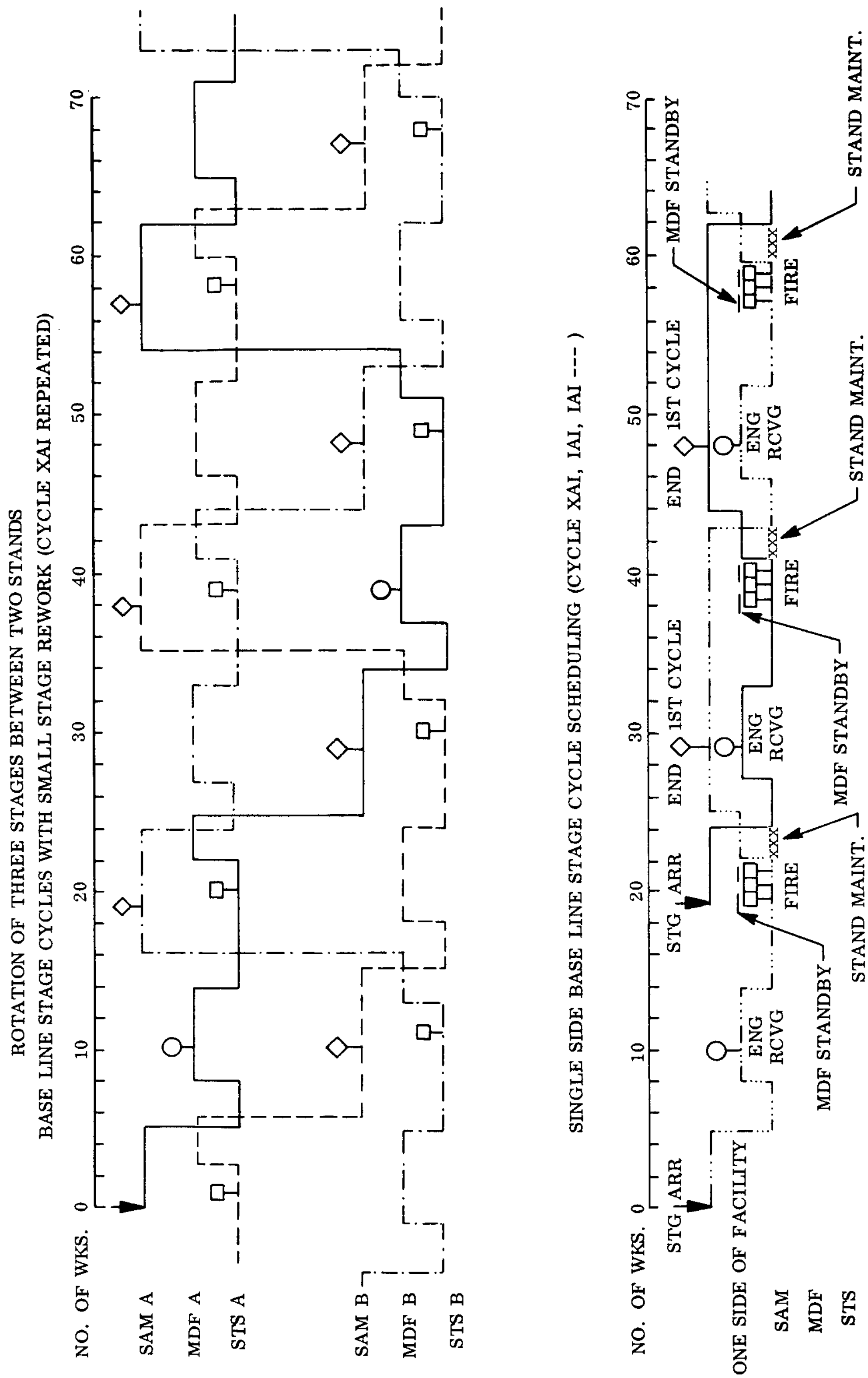

Fig. 5-4 Base Line Cycle Intermesh Possibilities

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normal sequence, it will be used to fully test the facility. When this is completed, the preparation or test operations for which the stage is brought to the facility will be conducted. This will result in S-N-TA-2 being fired on STS-4 on its first cycle and on STS-5 on its second cycle, provided that S-N-TA-2 is compatible with STS-5 and that its being fired on STS-5 does not interfere with expeditious cycling of S-N-T-X stages. Should there be reasons for not firing S-N-TA-2 during the ORD cycle on VTS-5, the stage will nevertheless be put through a cold soak and simulated count-down on that stand, prior to use of the stand for stage qualification testing of the S-N-T-X stages.

5.3 SCHEDULE OF OPERATIONAL PHASE OF RIFT NRDS OPERATIONS

Application of the estimates and assumptions in Section 5.2 results in the schedules of test operations shown in Figs. 5-5 and 5-6. The schedules are keyed to mile-stones shown in Fig. 5-1. In plotting the schedules, one week in the base line estimates is taken to be a quarter month. Note that under pessimistic assumptions the TA-2 stage is fired only twice during the entire operation; it is not fired on the STS 5.

With optimistic assumptions, on the other hand, TA-2 is fired on both STS 4 and STS 5, and it could be fired two more times in rotation with the flight stages at the expense of additional engine usage. In the scheduling shown in Fig. 5-5, however, TA-2 is put in storage after this second firing series and the three flight weight stages are cycled through the facility to result in the maximum number of stage qualification tests.

Annex A
ACTIVATION PLAN

A-1 TASK

During the activation phase RIFT NRDS Operations will perform the following:

- Participate in acceptance of newly constructed facilities
- Occupy completed facilities and assume responsibilities of facility management
- Install equipment listed in Section A. 4 in accordance with NSP Engineering technical direction
- Check out and accept responsibility for installed equipment

A. 2 ACCEPTANCE OF NEWLY CONSTRUCTED FACILITIES

The acceptance of RIFT facilities is primarily a contractual matter between SNPO-N, representing the government, and the contractors hired by the government to construct RIFT facilities. The acceptance is based upon design specifications, drawings, and contractual obligations. Most facility complexes will be judged by inspection of drawing conformity and equipment specification requirements. Items on which performance cannot be determined by these means will have an acceptance test (ATP) conducted prior to contractual acceptance.

After it has been demonstrated that the facilities and equipment have been delivered and installed in accordance with engineering design requirements, they will be released and turned over to RIFT NRDS operations. As the user of the facilities, LMSC has a primary interest in them, and RIFT NRDS will participate in the acceptance of the facilities to protect this interest. Representing the interest of LMSC will entail the following:

- Advising NVPO, FADO, and SNPO-N of any instances in which the facilities as built do not adhere to the designs or do not carry out the design intent

- Obtaining a complete reproducible set of shop drawings, vendor's drawings, maintenance instructions, and design drawings covering the facilities
- Introducing the foregoing documentation into the RIFT drawing system
- Witnessing all facility acceptance testing and procuring copies of the records

A. 3 OCCUPYING COMPLETED FACILITIES

The Manager, RNO Operations and Maintenance will be responsible for discharging the maintenance functions of facility managership. RNO Engineering will be charged with promulgating necessary operating instructions; the Manager, RNO Administration, will be responsible for keeping property records and promulgating necessary administrative instructions. Space in RIFT facilities and cognizance of items of property will be assigned by the Base Manager in accordance with detailed plans coordinated by the Chief Planner.

A. 4 INSTALLATION OF EQUIPMENT

The assumption is that LMSC will be responsible for installing most LMSC acquired equipment and as many blocks of facility plant equipment that are government furnished as it is convenient for the government to have LMSC install, to maintain a simple interface between contractor constructed facility and test apparatus.

A. 4. 1 LMSC Installed Equipment

- Local test stations (see 3. 2)
- Remote test stations (see 3. 2)
- Computer complexes (see 3. 2)

- Stage services, test stand, and fluid storage remote control and monitoring systems
- Stage umbilical connections
- Stage handling equipment
- Data acquisition systems
- Timing systems
- Technical communications systems
- Remote viewing television

A. 4. 2 Construction Contractor or Support Services Contractor Installed Equipment

In addition to providing site development and all structures, the construction contractors will install the following equipment:

- All standard, permanently installed shop equipment
- Permanently installed hoists, MDF turn tables; permanently installed remote handling equipment
- Test stand exhaust duct equipment, stand deluge and stand local control, and monitoring systems
- Fluid storage systems and storage system local control and monitoring systems
- Administrative communications
- Public address systems
- Site monitoring, alarm, and emergency communications systems
- Electric power, lighting, heating, ventilating, water, and sewerage systems and associated equipment

A. 4. 3 On-Site Transporter

Because of the complexity of the transporter, a single competent contractor should be responsible for the entire transporter, including its intimate interface with the stage. If LMSC were to be responsible, the transporter would first be assembled at the

RIFT Sunnyvale Complex; RNO would reassemble the transporter. If the transporter were to be furnished by another contractor, that contractor should be responsible for installing all equipment and for demonstrating the transporter during the activation phase. In this plan, the assumption is that LMSC will furnish the transporter to NRDS disassembled but completely configured and tested at Sunnyvale.

A. 4. 4 Electrical Test Equipment Installation

It is assumed that construction contractors will run cabling between structures, connecting it to terminal boxes within structures. Construction contractors will also provide conduits for test equipment wiring between rooms in a structure, foundations for equipment, power and ground connections brought to connection boxes, and equipment ventilation ducting to rooms of a structure. LMSC will install units of electrical test equipment, erect standard equipment racks, install trays for wiring, run wiring between terminal boxes and units of equipment, and install ventilation ducting between trunks and individual units of equipment. The scope of support service contractor assistance that is utilized will be consistent with the ground rules cited in Sections 4. 3. 3 and 4. 3. 4.

A. 4. 5 Propellant Storage and Transfer System Installation

It is assumed that the dewars, gas storage tanks, transfer piping, purge, vent, and vacuum systems, gas generators, and valves in the ground fluid storage and stage service systems up to, but not including, umbilicals will be installed by construction or support services contractors. It is also assumed that pneumatic/hydraulic control systems and electrical/electronic local control and local monitoring systems for fluid storage and transfer will be installed by construction or support services contractors. Remote control and remote monitoring equipment and test control equipment tying facility control and stage control systems together will be installed by LMSC. Likewise, stage service umbilicals will be installed by LMSC. NRDS support service contractors utilization will be as indicated in the ground rules cited in Sections 4. 3. 3 and 4. 3. 4.

A. 4. 6 Portable Equipment

LMSC will install portable furniture, bench equipment, portable office equipment, tools, spare parts, and supplies of consumables in space provided in newly occupied facilities.

Annex B
VALIDATION PLAN

B. 1 OBJECTIVE

The objectives of the validation phase of RIFT NRDS operations follow:

- To test the functional condition of the equipped facility and the compatibility of ground support equipment, the facility, and test articles
- To determine the adequacy of ground support equipment and facility to support the scope, character, and tempo of stage preparation and stage test specifications
- To establish the readiness of facility and equipment to commence operations with test stages
- To accomplish repairs and modifications necessary to remedy shortcomings discovered in carrying out the preceding objectives
- To develop operational procedures that best utilize the facility and equipment to achieve their intended purposes
- To train personnel in the operation and maintenance of facility and ground support equipment and in the operational procedures that will be employed with test stages during the operational phase

B. 2 RESPONSIBILITIES

During the activation phase, technical direction of equipment installation, responsibility for furnishing LMSC acquired equipment and special tools required in the installation, and responsibility for proper equipment operation rested with NSP Engineering. During the validation phase, after acceptance testing is accomplished, RNO has responsibility for operation and maintenance of equipment, including minor modifications and logistic support of these functions. During the validation phase, NSP Engineering will retain responsibility for designing updatings of ground support equipment necessitated by changes in test stages or stage test specifications. They will also be responsible for generating specifications and requirements for validation phase tests to satisfy NSP Engineering requirements for proof of equipment design. RNO will generate specifications and requirements for validation phase tests aimed at establishing operational suitability of the facility and equipment and demonstrating operational readiness to commence stage preparation, stage test, and stage post-test operations. The NSP approval agency will coordinate test specifications and test requirements. RNO will assume responsibility for initiating procurement of equipment, materials and support required for field operations or for accomplishing field-originated equipment modifications.

B.3 GENERAL DESCRIPTION OF VALIDATION PROCEDURES

B.3.1 Stage Assembly and Maintenance (SAM) Building Validation

Stage Assembly and Maintenance building validation will require verification of the utility of the combined elements of the building for stage assembly and checkout. The electrical power system will be tested with the stage checkout equipment operating, to test the available current-carrying capacity, outlet locations, and cable compatibility. Installed stage checkout equipment will be validated with electrical stage simulators installed in their intended locations to determine equipment interference, EMI, ground loops, and checkout equipment compatibility.

A mechanical stage simulator, consisting of a full-scale skeleton mockup of the stage and its external fixtures, will be used to determine building/stage interference, crane adequacy, transporter problems, checkout equipment locations, etc.

B.3.2 Stage Test Stand Validation

To verify the fit compatibility of the test stand complex, the mechanical stage simulator will be transported and installed in the test stand. Transporting and installing the mechanical stage simulator will also verify the operational compatibility of the transporter, scaffolding, remote umbilical attachments, hold-down mechanism, etc. A dimensional mockup engine will be attached to the stage simulator for this part of the STS validation.

To validate the STS local test stations, electrical umbilical test devices will be used in conjunction with stage interface substitutes and simulators that are parts of the electrical GSE installation.

A stage tank-bottom will be installed in the stand to validate altitude simulation, engine cell photography, etc.

A pneumatic and cryogenic umbilical test device that simulates stage and engine fluid systems by controlled return flow to dewars or dump lines will be installed at the umbilical disconnect plane to flow fluids through the umbilical equipment and to validate flow rates, pressure drops, topping computers, purge and LH_2 controls, etc. Simulation of the following will be achieved by properly designed systems of orifices and valves, manifolded as necessary, in combination with electrical analogs of stage equipment:

- Stage propellant tank fluid flow
- Stage propellant tank fluid flow
- Stage pressurization accumulator pressure
- Stage valve actions
- Stage pressurization transfer line dynamics

Flowing liquid hydrogen through the umbilical and umbilical test device will allow the safe dynamic flow and return to the storage system dump lines or separate catch tank. All control valves and regulator characteristics should be determined or validated during these tests.

The validation tests in the test stand will involve running emergency systems and a combined simulated captive test to verify the adequacy of all systems. The fluid systems will be validated in the following two phases:

- Operational adequacy of the controls and instrumentation
- Stage equipment compatibility

The stand validation should be run prior to the Stage Test Control Center combined systems validation, because in the latter operation all systems must be exercised with the assurance that the high pressure and hydrogen systems will operate properly and safely.

B.3.3 Stage Test Control Center (STCC) Validation

After the installation acceptance of the controls, instrumentation, and automatic checkout equipment in the STCC area, RIFT NRDS Operations will operate the equipment with installed electrical simulators and conduct combined systems validations tests using the previously described electrical umbilical test set and pneumatic and cryogenic umbilical test device in the STS, SAM and MDF. The validation tests will consist of a complete simulated stage captive test commencing with installation of the stage on the test stand and ending after post-test stage removal.

The following STCC equipment will be integrated and operated during the validation simulation tests:

- Computer complex
- Master test control console
- Television system
- Auxiliary display and control consoles
- Magnetic tape recorders
- Address and control decoder
- Checkout data demultiplexers
- Analog-to-digital converters
- Digital-to-analog converters

- Local test stations
- Remote test stations
- Cable termination and patch panels
- Power supply units
- Oscillograph and strip chart recorders
- Data acquisition equipment
- Operational test equipment
- Warning system display console
- Central timing control
- LH_2 storage and transfer console
- Facilities-monitoring console

B.3.4 Mate and Demate Facility (MDF) Validation

MDF facility validation will require the installation of the stage mechanical simulator with dimensional mockup NERVA for fit compatibility and handling tests. All anticipated mate and demate operations will be conducted on the stage tank bottom and dummy engine by manual and remote means. The dummy NERVA engine will be manually and remotely installed and removed from the stage tank bottom to establish the overall adequacy of the MDF building and equipment design prior to handling RIFT test stages. All procedures and techniques will be verified during the validation tests.

Electrical checkout equipment will be validated similarly to that in the SAM building.

B.3.5 Portable Test Equipment

No special validation tests are planned for the portable test equipment, other than determination of suitability of purpose and requirement during the validation period of the above described facilities. Test equipment that is found to be unsuitable will be modified, surplused, or exchanged for adequate equipment.

B.4 FACILITY SUPPORT EQUIPMENT VALIDATION

During validation of the NRDS primary facilities and equipment, certain support facilities and equipments will come into use. The suitability and usage of these items will be determined or estimated at that time. These facilities or equipment may be as follows:

- Fork lifts
- Portable cranes
- Shop equipment
- Storage facility equipment
- Photo support
- Calibration equipment
- Portable power
- Vehicles
- Vehicle maintenance equipment
- Fire protection
- Emergency vehicles
- Data reduction capability
- Portable and fixed illumination

Annex C

STAGE PREPARATION PLANS
(Typical Plan For Illustration)

STAGE RECEIVING AND INSPECTION

Receive Stage

- Transport stage to SAM on Overland Transporter (OLT)
- Verify that stage support stand is ready to receive stage
- Position OLT in SAM bay
- Verify that stage pressure does not indicate leaks (In case of leaks, attempt to locate prior to unloading.)
- Disconnect and cap OLT/stage pressurization system
- Remove protective covering from stage (package if reusable)
- Attach sling and shackle to handling rings using SAM bay overhead crane
- Lift stage from OLT in horizontal position
- Remove OLT from SAM bay; disassemble OLT and prepare for shipment to PTF
- Rotate stage to vertical position
- Remove shackle from stage
- Position stage over centerline of On Site Transporter (OST) tracks
- Move OST around stage
- Lower stage to OST (Orient stage to position required for proper placement in STS by OST.)
- Remove sling from stage

  Raise sling to maximum crane height

  Traverse crane to rear of bay
- Position stage on stage support stand
- Remove OST from SAM
- Inspect stage for shipping damage internally and externally. (Initiate fix actions as required.)

- Receive stage subassemblies
- Perform subassembly Receiving Inspection
- Calibrate and check out subassemblies
- Move subassemblies to SAM bay

Stage Subassembly Assembling and Modification

- Assemble parts and subassemblies
- Perform necessary engineering modifications
- Install IU or IU substitute connections

Perform Systems Tests

- Electrical Systems

  Apply power and determine that correct voltages are obtained

  Determine that no undesirable grounding exists

  Determine electrical interface compatibility of RIFT stage with other stages, by use of stage electrical simulators
- Guidance and Control System

  Check functionally for alignment

  Verify that the displacement and rate gyros performance is within tolerances and that proper output voltages are obtained

  Confirm proper static gain, phasing linearity, threshold, and dynamic response
- Propellant, Pneumatic, and Auxiliary Propulsion Systems

  Check valves and regulators for proper operation

  Leak check all critical points within the system, plumbing joints, disconnects, bleed and relief valves, and topping and shutoff valves

  Determine pressure drop versus time
- Electronic Systems

  Check Azusa transponder for power output, closed-loop noise modulation, static and dynamic phase shift, modulation frequency response, and dynamic offset frequency error

  Functionally test the rf tracking systems, destruct command system, and telemetry systems

Cold Soak Tests

- Transport to STS on OST
  - Remove work platforms and disconnect cables from stage
  - Move OST around stage
  - Verify that weather permits transportation
  - Lift stage from stand with OST
  - Verify that STS is ready to receive stage for cold soak test
  - Transport stage to STS with OST
  - Position stage on STS
  - Engage stage holdown clamps
- Prepare for Cold Soak Test
  - Connect instrumentation and liquid/gas umbilicals
  - Checkout instrumentation
  - Purge: GN_2 followed by GH_2
- Perform Cold Soak Test
  - Fill stage with LH_2; begin with slow fill for chilldown and then rapid fill to specified level
  - Evaluate insulation integrity; IR scan of tank for cold spots
  - Record data to verify structure and insulation integrity and that no leaks exist; use H_2 sniffer to detect leaks
  - Drain stage and purge with GH_2 followed by GN_2 followed by air
  - Disconnect and secure instrumentation and liquid/gas umbilicals
  - Move OST into position and disengage stage holddown clamps
  - Remove stage from STS with OST
- Transfer Stage to MDF
  - Verify that MDF is ready to receive stage
  - Transport stage from STS to MDF on OST
  - Raise stage to support stand clearance height
  - Position OST around support stand
  - Lower stage on support stand
  - Remove OST from MDF bay
  - Inspect tank internally for insulation failure
  - Initiate fixes as determined necessary from cold soak tests. (If necessary return stage to SAM for repair)

Stage and Enginc Mate and Checkout

- Receive Engine

  Notify AGC that stage is ready for engine

  Transport engine from EMAD to MDF on EIV (EIV operated by AGC personnel)

  Perform receiving inspection on engine

- Perform Engine Checkout
- Mate Engine and Stage

  Position engine in mating position using EIV (EIV operated by AGC personnel)

  Mate engine and engine control and monitoring systems to stage

  Remove EIV from MDF

  Install work platforms

  Perform stage engine alignments

- Perform Integrated Systems Tests

  Verify all test stations and simulators connected to stage

  Verify external GN_2 supply connected to stage

  Pressurize stage and engine pressurization systems to rated values with GN_2

  Pressurize stage to 26 psia

  Set vehicle power to "external"

  Install rechargeable batteries in vehicle

  Check power on all buses and turn on all vehicle equipment

  Calibrate T/M systems over coaxial line

  Duplicate appropriate commands from guidance computer through the switch selector, through propulsion and pyrotechnic control units to...

  Control LH_2 main valve reducing tank pressure

  Control pressurization system to return tank to 26 psia

  Control for tank venting to 19 psia

- Simulate a G & C output to the switch selector for a signal to the Flight Control Computer through the flight sequence distributor to bring about discrete commands of importance

- Simulate guidance signal processor analog signals to the Flight Control Computer and monitor engine actuator movement and GN_2 from attitude control rockets
- Simulate guidance computer output through the switch selector, propulsion and pyrotechnic control unit to engine computer to bring about control rod signals
- Send electrical stimuli to C-band and Mistram transponders and observe output over coax
- Send destruct signals over coaxial line and monitor results
- Simulate signals to bring about any other discrete commands of importance (separation, squib-operated valves, etc.)
- With umbilicals in and antennas on coaxial line, run through a simulated flight

  Trigger transponder and send commands to stage

  Switch to internal power, switch antennas from coax to radiate, break all electrical umbilicals and repeat the simulated flight

  Trigger transponders and send commands by RF

  Note: The neutron source may be installed at this point. Exact time and place of installation will be determined later.

Prepare for Transfer to STS

- Check that all vehicle equipment is secured properly and remove test equipment
- Disconnect umbilicals and test cables
- Cover exposed equipment, connectors, couplings, and engine nozzle
- Remove access platforms, catwalks, and portable stands from around stage
- Position OST around stage support stand
- Lift stage from support stand with OST (Check that stage is oriented properly for placement in STS)

Transport Stage to STS with OST

Annex D

TEST PLANS
(Typical Plan Included For Illustration)

TRANSPORT STAGE TO STS ON THE ON-SITE TRANSPORTER (OST)

- Install stage on STS
- Secure stage holddown clamps
- Remove OST from STS area

PRE-CAPTIVE FIRING TEST AND CHECKOUT

- Electrical

  Connect electrical umbilicals to the stage

  Check for continuity, shorts, and grounding of all electrical/electronic lines between the STCC and the stage

  Apply power to the stage from an external source (28 VDC and 56 VDC)

  Check for proper voltages, currents, and switch positions at all monitored points

  Switch to internal power

  Check for proper voltages,currents,and switch positions at all monitored points

  Switch to external power

- Electronic

  SS/FM

  Send a calibration command signal to actuate relays within the SS/FM telemetry assembly to connect the inputs of all channels in parallel

  Impress a signal from the GSE on the inputs

  Sweep the signal through the frequency range covered by the transducer and multiplexer inputs to the assembly

  Verify proper output of the assembly

  Return the system to normal operating configuration

PAM/FM/FM

Switch the continuous data inputs from the FM/FM channels to spare PCM multiplexer channels

Monitor PAM and PCM outputs through the PCM/DDAS system during checkout of the stage transducers, VCO's, and multiplexers

VCO's

Switch the inputs of the VCO's to the calibration signals (five sequenced voltages) of the central calibrator

Verify proper outputs

Return the VCO inputs to the measuring subsystem

PAM Multiplexers

Use the stage central calibrator to send command signals to the PAM multiplexers (six signals each of 700 milliseconds)

Monitor the outputs to verify that each multiplexer generates a five step reference signal (0. 1, 1.25, 2.50, 3.75 and 5.00 volts ± 1%) upon receipt of the command signal.

Transducers

Verify that checkout calibration modules are plugged in the measuring racks for the stage thermocouples and flow, rpm, bridge, potentiometer, and piezoelectric transducers, and the integrated amplifier/ sensors

Use the Channel Selection System to send a high and low and an off, or run, command to each data channel

Monitor the output of each data channel on the DDAS

Transmitter Power

Determine the transmitter power and reflected power through the DDAS via the telemetry subsystem and the RF signal

RF Signal

Determine the modulation and carrier frequency through a coaxial line from the RF switch or from the radiation

Flight Termination and Stage Separation System

(To be included later if all or part of these systems are installed for static tests at NRDS)

Special Sensors

(In place checkout and calibration of special sensors will be included later)

- Gas and Liquids

  Connect forward and aft gas/liquid umbilicals (if not integral with electrical umbilicals)

  Sweep purge equipment bay with GN_2 to less than 1% 0_2

  Maintain GN_2 pressure in equipment bay between 0. 5 and 1. 0 psig

  Purge Instrument Unit (details to be included later)

  Purge the area external to the engine and stage aft end with GN_2 to less than 1% 0_2

  Maintain positive pressure in this area.

  Pressurize the stage pressurization system with GN_2 and exercise actuators until 0_2 is less than 1%

  Check that the accumulator safety valve opens at 860 psi, by increasing pressure to this level

  Pressurize the propellant tank with GN_2 through the fill line. Combine pressure sweeps and pressure cycles to reduce 0_2 concentration to an acceptable level (If cold gas attitude control system is used, purge this system by opening the valves and allowing GN_2 flow through the valves and nozzles

  Verify that the tank safety valve opens at the proper pressure

  Pressurize the stage pressurization system with GH_2 and exercise the actuators until GN_2 concentration is at an acceptable level.

  Purge the NERVA accumulators (details to be developed upon receipt of final design information from AGC)

  Purge the NERVA engine with GHe until 0_2 concentration is at an acceptable level. (GHe via aft umbilical to a port on the pre-valve body and then through the engine cooldown valve)

  Repeat the GN_2 purge procedure for the propellant tank using GH_2 until the GN_2 concentration is at an acceptable level (Maintain a positive pressure on the tank)

  Verify that all transducers, sensors, and valve position indicators are switched to the correct multiplexer channels for readout by DDAS or ground stations

- Captive Test

  Begin cooldown LH_2 flow at 650 gpm

  When tank is cooled down, begin fast flow of 10,000 gpm

  At 98% of final loading, go to slow fill of 650 gpm and continue to desired level (Set tank pressurization system to maintain 1–6 psig during fill)

  Switch to internal power

  Disconnect electrical umbilical (flight systems only)

  Verify that all stage and GSE systems are GO

  Send subpower start signal to engine programmer

  Monitor all systems for proper operation

  Verify that the reactor reaches 1% power and holds

  Open prevalve

  Send START signal to engine programmer

  Monitor all systems for proper operation

  At end of desired run time send SHUTDOWN signal to the engine programmer

  Monitor all systems for proper operation, particularly the engine cooldown system

  Connect electrical umbilical to stage

  Switch to external power

  When the engine temperature reaches a safe level, switch the after cooling to GSE; monitor and record engine temperatures continuously

- Post-Test

  Drain residual LH_2 from stage and purge all systems of GH_2 with GN_2 or GHe

  Repeat the prerun checkout and calibration of all stage systems; record results for PRE/POST comparison of performance; note and isolate faults

  Verify that engine temperature rise rate without cooling is low enough to permit transfer from the STS by the OST

  Disconnect umbilicals

  Engage the stage with the OST

Release the stage hold down clamps

Lift the stage with the OST

Transport the stage to MDF

Note: If the engine is to be test fired again and no repairs to the stage are necessary that cannot be made with the stage on the STS, the stage will not be removed from the stand.

Annex E

POST-TEST PLANS
(Typical Plan For Illustration)

Transport stage from STS to MDF, on OST

Monitor radiation levels inside and outside OST cab continuously during transit to assure a safe level and noncriticality

Provide reactor cooling as required to maintain a safe temperature during transit

Install stage on turntable in MDF

Remove OST from MDF

Rotate stage for inspection by direct viewing through windows and by TV cameras and/or periscopes

Note and photograph areas of damage or interest

Remove flux monitoring foils from stage and send to counting room for processing

Bring EIV into demating cell and attach it to the engine (AGC personnel)

Demate engine from stage

Transport engine to EMAD (AGC)

Remove equipment from the stage that is to be repaired, modified, or replaced; decontaminate and transfer to the appropriate shops

Decontaminate the stage to reduce radioactivity to a level acceptable for transfer of the stage to SAM

Bring OST into MDF and engage the stage

Lift the stage and transport it to SAM

> Note: If the radiation levels are too high for work to be performed in SAM, the stage will be transported to a cooldown area to allow the radiation to decrease by decay to a level acceptable for transfer to SAM

Position the stage on the stage support stand in SAM

Inspect the stage internally and externally for damage or failure

Repair all damage or failure of the stage and stage systems

Perform outstanding Engineering Order Changes on the stage

> Note: If the same engine is to be refired on the same stage, the inspection and repairs will be performed in the MDF with the engine and stage mated.

Begin preparation of the stage for the next series of firings

Annex F
MANPOWER AND SUBCONTRACT REQUIREMENTS

The manpower estimate presented on the following charts is based upon expected facility buildup and activation. The charts are coded according to organizational structure versus milestone events. The milestones are presented in accordance with the facility schedule in Fig. 5-2, and the organization structure in accordance with Fig. 4-1.

The manpower estimates are intended to include all of Lockheed Missiles & Space Company personnel required for the RIFT program at NRDS. In this preliminary estimate no attempt is made to estimate the personnel requirements by the task statements presented in RNO Task Structure, Section 4. 4.

	Start of Planning	Start of Construction	Begin Buildup	Occupy SAM & STCC	Occupy MDF A & STS 4	Begin Validation	TA-2 Arrival Begin ORD Occupy MDF B & STS 5	T-1 Arrives	T-3 Arrives	Begin Phaseout
RIFT NRDS Operations										
RNO Safety Staff	1	1	1	1	1	2	2	2	2	2
Safety Analysis & Plans			1	1	1	2	2	2	2	2
OPS Monitoring						1	2	3	4	4
Radiation Safety					1	2	4	4	4	4
Industrial Safety				1	1	2	3	3	3	3
Health			1	2	2	2	2	2	2	2
RNO Checkout & Inspection	1	1	1	2	2	2	3	3	3	3
TA-2 Crew							12	12	12	
T-1 Crew								12	12	12
T-2 Crew								12	12	12
T-3 Crew									12	12
Inspection		1	1	2	3	6	8	8	8	8
Standards Laboratory			1	3	4	5	5	5	5	5
Failure Mode		1	1	1	1	2	2	2	2	2
Receiving Inspection			4	6	6	6	6	6	6	6
RNO Operations & Maint., Staff 1	1	2	5	6	7	8	10	10	10	10
SAM Building		1	4	6	8	12	16	20	20	20
MDF		1	2	4	8	12	16	16	16	16
Transporter			1	3	5	7	7	7	7	7
Mech Shop			1	5	9	9	9	9	9	9
STS 4		1	1	2	10	12	15	15	15	15
STS 5					1	3	12	15	15	15
STCC			1	2	2	2	2	2	2	2
Valve Shop			1	4	4	4	4	4	4	4
Control & Monitor		1	10	20	20	30	40	40	40	40
Computers			1	5	5	5	10	10	10	10
Data Acq.			2	10	10	20	20	20	20	20
Electronics Shop			1	10	10	10	10	10	10	10
Test Plans & Ops.		1	1	2	4	6	6	8	8	8

	Start of Planning	Start of Construction	Begin Buildup	Occupy SAM & STCC	Occupy MDF A & STS 4	Begin Validation	TA-2 Arrival Begin ORD Occupy MDF B & STS 5	T-1 Arrives	T-3 Arrives	Begin Phaseout
RNO Engineering	1	2	4	6	6	6	6	6	6	6
Work Planning			2	6	6	6	6	6	6	6
Stage Engineering		1	1	1	2	4	4	6	6	6
GSE Engineering		1	6	12	12	12	12	12	12	12
Facility Engineering		1								
Test Requirements		1	1	1	2	2	2	2	2	2
Computer Program			1	4	4	6	6	6	6	6
Data Reduction						2	4	5	6	6
Test Reports						1	2	3	4	4
Ops. & Maint. Instr.				2	2	2	2	2	2	2
Documentation				4	4	4	4	4	4	4
Administration		1	2	2	2	2	2	2	2	2
Personnel & Security			8	8	8	8	8	8	8	8
Finance & Office Ops.			7	8	9	10	10	10	10	10
Supply & Prop.			11	11	11	11	11	11	11	11
Art Work & Editorial				2	2	3	3	3	3	3
Services				5	10	15	15	15	15	15
Base Management	1	2	2	3	4	4	4	4	4	4
Plans & Liaison		2	4	6	8	8	8	8	8	8
Tech Staff				2	3	4	4	4	4	4
TOTALS										

Annex G

NRDS SUPPORT REQUIREMENTS

(Not presented at this time)

Annex H

PLANT EQUIPMENT REQUIREMENTS

(Not presented at this time)

Annex I

DOCUMENTATION AND DESIGN CONTROL

(Not presented at this time)

Annex J

SAFETY IMPLEMENTATION

(Not presented at this time)

Annex K

QUALITY IMPLEMENTATION

(Not presented at this time)

Annex L
TRAINING PROGRAMS

A training program will be developed and carried out for RIFT NRDS personnel to assure that all are qualified to perform their assigned jobs. Training will be oriented to train personnel in the details of RIFT procedures and systems in areas of their specialty and to indoctrinate them in all areas of RIFT procedures and systems. Both on-the-job and formal classroom type training will be used.

On-the-job training will be carried out in several areas to allow personnel to gain additional experience in the area of their specialty, to maintain state-of-the-art knowledge, and to learn details of the RIFT procedures and systems. Personnel scheduled for RIFT NRDS organization membership will be assigned to work at the cryogenics facility at Santa Cruz Test Base, the RIFT Propellant Tank Facility, RIFT Cold Flow Facility, NRDS (as LASL Industrial Staff Members and with WANL and AGC in assignments to be negotiated), and within other RIFT organizations performing types of work that will later be performed by the RIFT NRDS organization.

Formal classroom training will be carried out at the RIFT Sunnyvale complex for personnel scheduled to become members of the RIFT organization at NRDS and at NRDS for RIFT personnel there. These training courses will have the same purpose as the on-the-job training and will concentrate on areas of RIFT peculiar procedures, equipment, and technology and areas where it is not possible to obtain the necessary quantity of personnel with the desired amount of experience or types of skills. These courses will be organized and conducted by the LMSC Training department to meet the requirements established by RIFT NRDS management. Guest lecturers and instructors will be used to complement the training department personnel.

Training will be carried on throughout the program to train and indoctrinate new personnel and to allow all personnel to maintain state-of-the-art knowledge of the RIFT procedures and equipment and of their fields of specialties.

Details of the types and content of the courses will be developed in later revisions of this document.

Annex M

REPORTING PLAN

(Not presented at this time)

TERMS AND ABBREVIATIONS USED

Abbreviation	Meaning
AE	Architect-Engineer
AGC/REON	Aerojet-General Corporation (The NERVA engine contractor)
CFF	Cold-Flow Facility (Facility at the RIFT Sunnyvale Complex used for tests performed with cryogenic fluids)
CMC	Construction Management Contractor (For NRDS)
CSA	Central Support Area (In NRDS)
CTC	Chief Test Conductor (In the captive-test organization)
CT-X	Captive Test (Series No. X)
DDAS	Digital Data Acquisition System
DF	Demating Facility
DIP	Design Information Package
EIS	Engine Interface Substitute
EIV	Engine Installation Vehicle (To transport engine between EMAD and MDF)
EMAD	Engine Maintenance Assembly and Disassembly (Building at NRDS, operated by AGC)
EM	Engineering Memorandum (Form)
EO	Engineering Order (Form)
FADO (FDO)	Facilities Design Office (At MSFC)
FLAG	Facilities Liaison Group
FM	Frequency Modulation
G&C	Guidance and Control
GHe	Gaseous Helium
GH_2	Gaseous Hydrogen
GN_2	Gaseous Nitrogen

Abbreviation	Meaning
GSE	Ground Support Equipment
GVX	Ground test block of NERVA engines
IU	Instrument Unit (Saturn vehicle common guidance and control module)
IUIS	Instrument Unit Interface Substitute
Kiwi	LASL ROVER reactor test device
LASL	Los Alamos Scientific Laboratory
LCS	Local Control Station
LH_2	Liquid Hydrogen
LMSC	Lockheed Missiles & Space Company
LSIS	Lower Stage Interface Substitute
LTS	Local Test Station
MDF	Mate-Demate Facility (In NRDS)
MSFC	Marshall Space Flight Center
NAB	Nuclear-Stage Assembly Building (At the launch site)
NERVA	Nuclear Energy Rocket Vehicle Application (AGC/WANL-provided nuclear rocket engine to power RIFT stage)
NRDS	Nuclear Rocket Development Station (Jackass Flats, Nevada)
NSP	Nuclear Space Programs (Organization within LMSC responsible for the S-N Stage (RIFT) Program)
NVPO	Nuclear Vehicle Projects Office (Organization within MSFC responsible for the S-N Stage (RIFT) Program)
OLT	Overland Transporter (For delivering RIFT stage to remote sites)
ORD	Operational-Readiness Demonstration (Facility-validation live-run test)
OST	On-site Transporter (For moving RIFT stage between NRDS facilities)
PA	Public Announcing
PAM	Pulse Amplitude Modulation
PCM	Pulse Code (digital) Modulation

Abbreviation	Meaning
PFRT	Preliminary Flight Rating Test (Engine test to verify design adequacy and capability for design-level performance for limited periods)
PTF	Propellant Tank Fabrication (Facility at Moffett Field, California)
RF	Radio Frequency
RIFT	Reactor-In-Flight-Test (Program for developing a vehicle utilizing nuclear propulsion in space flight)
RNO	RIFT NRDS Operations (Organization within LMSC NSP responsible for RIFT captive-test program at NRDS)
Rover	Total nuclear-rocket development program
RSC	RIFT Sunnyvale Complex (All facilities in Sunnyvale-Moffett Field area used primarily in support of RIFT)
SAM	Stage Assembly and Maintenance (Building at NRDS)
SIS	Stage Interface Substitute
S-N	Stage-Nuclear (RIFT)
S-N-X	RIFT Flight Stage (Series No. X)
SNPO	Space Nuclear Propulsion Office (Joint NASA-AEC organization responsible for nuclear-rocket propulsion program)
SNPO-N	Extension office of SNPO at NRDS
S-N-T-X	RIFT flight-type stage for captive test (Serial No. X)
S-N-TA-X	RIFT heavy-gage (battleship) stage for ground test (Serial No. X)
SOP	Standard Operating Procedure (For NRDS; promulgated by SNPO-N)
SOST	(See OST)
SSC	Support Services Contractor (For NRDS)
STCC	Stage Test Control Center (In NRDS)
STS-X	Stage Test Stand (Serial No. X)
S-V-N	Saturn V-N (Vehicle comprising the S-I-C, SII, and S-N stages with IU and some payload)
T/M	Telemetry
T&PA	Test and Product Assurance (Directorate in NSP)

Abbreviation	Meaning
TSIS	Test Station Interface Substitute
TSOV	Tank Shutoff Valve (Main propellant valve in RIFT stage)
VCO	Voltage Controlled Oscillators (For frequency modulators)
WEC/WANL	Westinghouse division responsible for developing NERVA reactor core under subcontract to AGC.

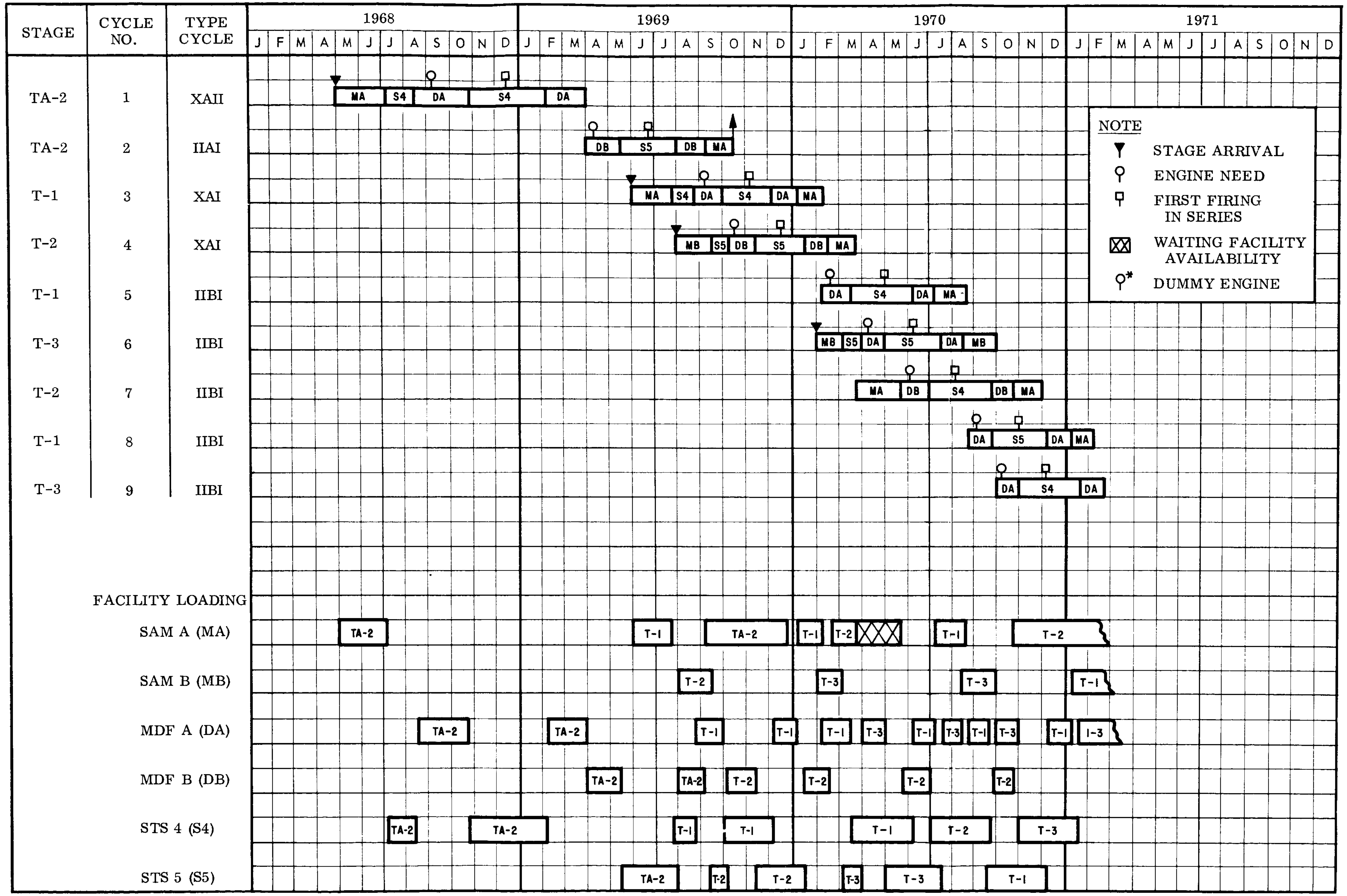

Fig. 5-5 Operational Phase Schedule (Optimistic Assumptions)

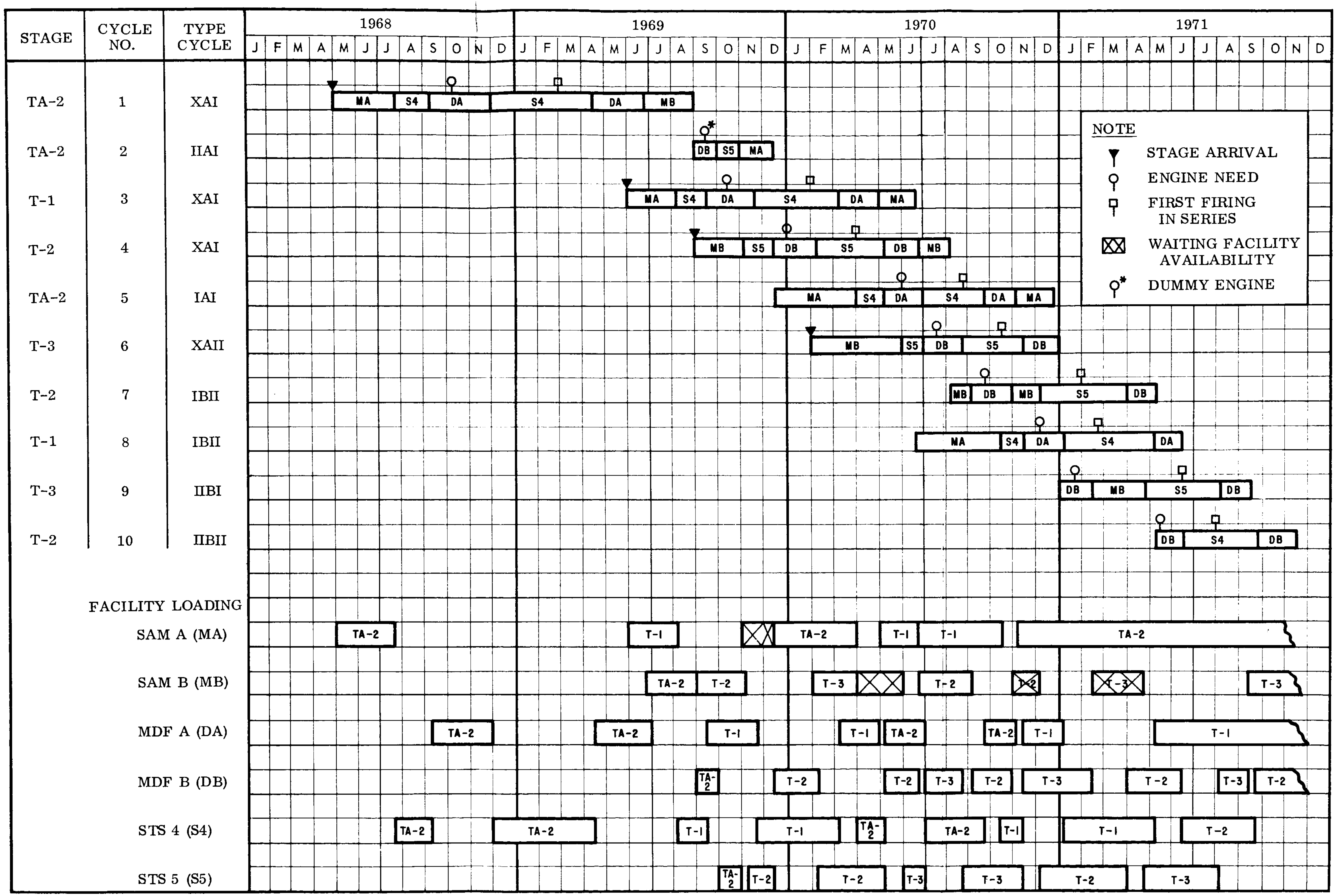

Fig. 5-6 Operational Phase Schedule (Pessimistic Assumptions)

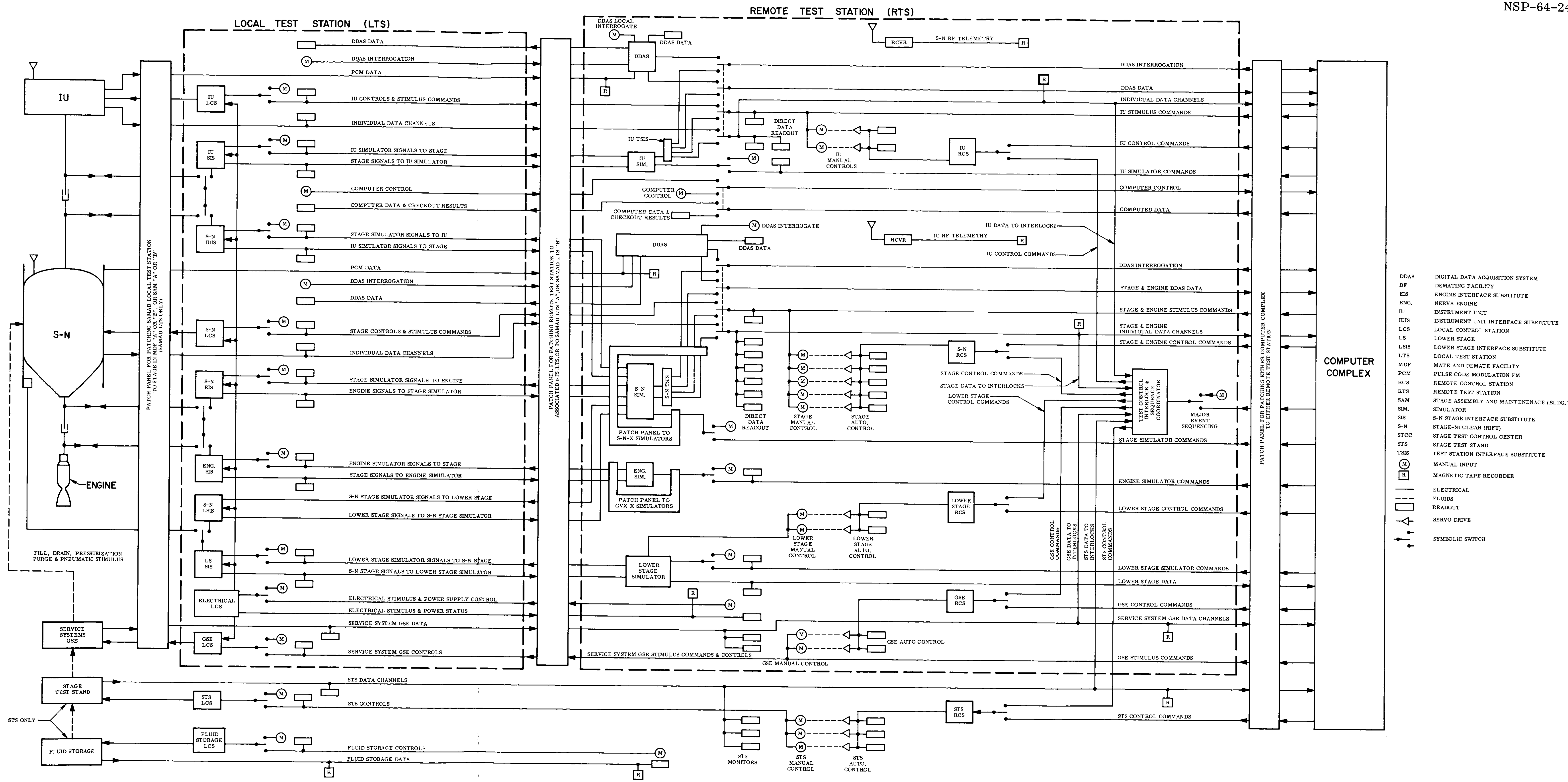

Fig. 3-9 RIFT NRDS Electrical Test Equipment Functional Diagram

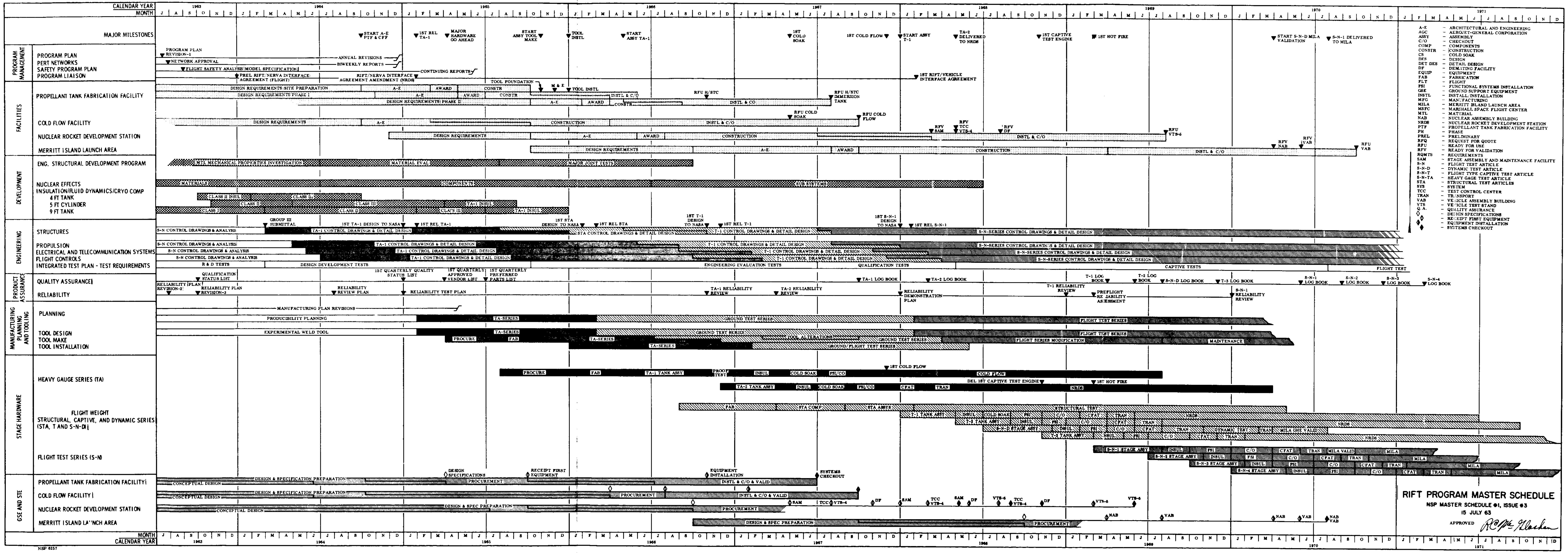

Fig. 5-1 RIFT Program Master Schedule